DRAFT

Treatability Study in Support of Remediation by Natural Attenuation (RNA) for the BX Shoppette (Site E11)

Eaker Air Force Base
Blytheville, Arkansas

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas

and

Air Force Base Conversion Agency/OL-J
Eaker Air Force Base
Blytheville, Arkansas

January 1997

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DRAFT

TREATABILITY STUDY IN SUPPORT OF REMEDIATION BY NATURAL ATTENUATION (RNA) FOR THE BX SHOPPETTE (SITE E11)

at

EAKER AIR FORCE BASE
BLYTHEVILLE, ARKANSAS

January 1997

Prepared for:

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
TECHNOLOGY TRANSFER DIVISION
BROOKS AIR FORCE BASE
SAN ANTONIO, TEXAS

AND

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BLYTHEVILLE, ARKANSAS

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EXECUTIVE SUMMARY

This report presents the results of a treatability study performed by Parsons Engineering Science, Inc. (Parsons ES) at the BX Shoppette (Site E11), Eaker Air Force Base, Arkansas to evaluate remediation by natural attenuation (RNA) of dissolved fuel hydrocarbons. Mobile and residual light, nonaqueous-phase liquid (LNAPL) present within the vadose zone and phreatic soils serves as a continuing source for the dissolved groundwater contamination. This study focused on the fate and transport of dissolved benzene, toluene, ethylbenzene, and xylene (BTEX) in unconfined and semi-confined groundwater at the site. Site history and the results of soil and groundwater investigations conducted previously are also summarized in this report.

BTEX data collected in March 1996 as part of this TS indicated that the upper two water bearing units (the shallow unconfined and the deep, semi-confined aquifers) at the site contain BTEX contamination. Geochemical data strongly suggest that biodegradation of fuel hydrocarbons is occurring in both aquifers via aerobic respiration and the anaerobic processes of iron reduction, manganese reduction, sulfate reduction, and methanogenesis. Patterns observed in the distribution of hydrocarbons, electron acceptors, and biodegradation byproducts further indicate that biodegradation is reducing dissolved BTEX concentrations in both groundwater aquifers.

An important component of this study was an assessment of the potential for contamination in groundwater to migrate from the source areas to potential receptors. The analytical model Bioscreen (version 1.2) was used to evaluate the fate and transport of dissolved BTEX in unconfined and semi-confined groundwater under the influence of advection, dispersion, sorption, and biodegradation. Input parameters for the Bioscreen model were obtained from previous site characterization data, supplemented with data collected by Parsons ES. Model parameters that were not measured at the site were estimated using reasonable literature values.

The results of this demonstration suggest that RNA of BTEX is occurring at the BX Shoppette; furthermore, the estimated rates of biodegradation, when coupled with the effects

of sorption, dispersion, and dilution, should be sufficient to reduce dissolved BTEX in the unconfined and semi-confined aquifers to concentrations below current regulatory guidelines long before potential downgradient receptors could be adversely affected. However, dissolved concentrations of BTEX are predicted to remain in shallow unconfined site groundwater for more than 100 years without engineered source reduction. When bioventing and source excavation are incorporated into the site groundwater model, the model predicts it will take less than 20 years to reduce dissolved benzene concentrations to below the federal MCL of 5 µg/L. The presence of a state-permitted land farm at Eaker AFB that is capable of accepting excavated hydrocarbon-contaminated soils from the BX Shoppette was influential in the selection of a final remedial alternative. A combination of rapid source removal [with a corresponding decrease in potential long-term monitoring (LTM) operations] and reduced excavation costs (resulting from the close proximity of the land farm to the BX Shoppette) make source excavation a very competitive remedial alternative. Therefore, source excavation coupled with RNA and LTM is the most viable remedial option for BTEX-impacted groundwater at the site.

To verify the results of the analytical modeling effort, and to ensure that RNA is occurring in the shallow unconfined and deep semi-confined aquifers at rates sufficient to protect potential downgradient receptors, groundwater from 6 LTM wells, 5 sentry wells, and 3 surface water sampling locations should be sampled and analyzed for BTEX compounds by US Environmental Protection Agency (USEPA) Method SW8020. These wells should be sampled annually for 15 years. At that time, sampling could cease, decrease in frequency, or continue annually as dictated by the analytical results. If during annual monitoring dissolved BTEX concentrations in groundwater collected from the sentry wells exceed federal MCLs, additional evaluation or corrective action may be necessary at this site.

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SECTION 1

INTRODUCTION

This report was prepared by Parsons Engineering Science, Inc. (Parsons ES) and presents the results of a treatability study (TS) conducted to evaluate the remediation by natural attenuation (RNA) of groundwater contaminated by gasoline at the BX Shoppette (Site E11), Eaker Air Force Base (AFB, the Base), Blytheville, Arkansas. As used throughout this report, the term "RNA" refers to a management strategy that relies on natural biological, physical, and chemical attenuation mechanisms to control exposure of receptors to concentrations of contaminants in the subsurface that exceed regulatory levels intended to be protective of human health and the environment.

RNA is an innovative remedial approach that relies on natural attenuation to remediate fuel contaminants dissolved in groundwater. Patterns and rates of RNA can vary markedly from site to site depending on governing physical, chemical, and biological processes. Mechanisms for natural attenuation of fuel hydrocarbons include advection, dispersion, dilution from recharge, sorption, volatilization, and biodegradation. Of these processes, biodegradation is the only mechanism working to transform contaminants into innocuous byproducts. Natural biodegradation occurs when indigenous microorganisms work to bring about a reduction in the total mass of contamination in the subsurface without artificial intervention (e.g., the addition of nutrients). The main emphasis of the work described herein was to evaluate the potential for naturally occurring biodegradation mechanisms to reduce dissolved fuel hydrocarbon concentrations in groundwater to concentrations below regulatory standards that are intended to be protective of human health and the environment. This study is not intended to be a contamination assessment report or a remedial action plan for the BX Shoppette; rather, it is provided for the use of the Base and its prime environmental contractor(s) as information to be used for future decision making regarding this site.

1.1 SCOPE AND OBJECTIVES

Parsons ES was retained by the United States Air Force Center for Environmental Excellence (AFCEE) Technology Transfer Division to conduct site characterization and groundwater modeling to evaluate the scientific defensibility of RNA with long-term monitoring (LTM) as a remedial option for fuel-contaminated groundwater at the BX Shoppette. Site characterization activities conducted in March 1996 consisted of numerous tasks that were required to fulfill the project objective. These tasks included:

- Reviewing existing hydrogeologic and soil and groundwater quality data for the site;
- Conducting supplemental site characterization activities to determine the nature and extent of soil, sediment, surface water, and groundwater contamination and the groundwater flow conditions in the affected aquifer;
- Collecting geochemical data in support of RNA;
- Developing a conceptual hydrogeologic model for the shallow saturated zone, including the current distribution of contaminants;
- Evaluating site-specific data to determine whether naturally occurring processes of contaminant attenuation and destruction are occurring in groundwater at the site;
- Designing and executing a Bioscreen groundwater flow and solute transport model for site hydrogeologic conditions;
- Simulating the fate and transport of fuel hydrocarbons in groundwater under the influence of advection, dispersion, adsorption, and biodegradation using the Bioscreen model;
- Evaluating a range of model input parameters to determine the sensitivity of the model to those parameters and to consider several contaminant fate and transport scenarios;
- Determining if naturally occurring processes are limiting dissolved hydrocarbon plume expansion so that water quality standards can be met downgradient;
- Assessing potential exposure pathways for potential current and future receptors;
- Developing remedial action objectives (RAOs) and reviewing available remedial technologies;
- Using the results of modeling to recommend the most appropriate remedial option based on specific effectiveness, implementability, and cost criteria; and
- Providing a LTM plan that includes LTM and sentry wells.

Site characterization activities completed in March 1996 in support of RNA included exploration of the subsurface with a cone penetrometer (CPT) and laser probe tip [laser induced fluorescence (LIF)]; placement of monitoring points and collection of soil samples with the CPT apparatus; collection of soil samples with a Geoprobe®; aquifer testing; static groundwater level measurement; groundwater sample collection from site monitoring wells and points; surface water and sediment sample collection from site surface water bodies; analysis of groundwater, soil, surface water and sediment samples; and collection and analysis of free product from site monitoring wells. Field investigation methods are described in the TS Work Plan (Parsons ES, 1996).

Site-specific data were used to develop a solute fate and transport model for the site using Bioscreen and to conduct a preliminary exposure pathways analysis. The modeling effort was used to predict the future extent and concentration of the dissolved contaminant plume by modeling the combined effects of advection, dispersion, sorption, and biodegradation. Results of the model were used to assess the potential for completion of receptor exposure pathways involving groundwater, and to determine whether RNA with LTM is an appropriate and defensible remedial option for contaminated groundwater. The results of this TS will be used to provide technical support for the RNA with LTM remedial option during regulatory negotiations, as appropriate.

Alternate remedial options were considered to identify the major advantages and disadvantages associated with different groundwater remedial strategies. Hydrogeologic and groundwater chemical data necessary to evaluate these remedial options were either collected under this program, or were available from previous site investigations or the technical literature. Field work conducted under this program, however, was oriented toward the collection of supplementary hydrogeologic and geochemical data necessary to document and model the effectiveness of RNA with LTM for restoration of fuel-hydrocarbon-contaminated groundwater.

1.2 REPORT ORGANIZATION

This TS contains nine sections, including this introduction, and six appendices. Section 2 summarizes site characterization activities. Section 3 summarizes the physical characteristics of the study area. Section 4 describes the nature and extent of soil, groundwater, surface water, and sediment contamination, and the geochemistry of soil

and groundwater at the site. Section 5 describes the Bioscreen model and design of the conceptual hydrogeologic model for the site; lists model assumptions and input parameters; and describes sensitivity analyses, model output, and the results of the Bioscreen modeling. Section 6 presents a comparative analysis of remedial alternatives. Section 7 presents the LTM plan for the site. Section 8 presents the conclusions of this work and provides recommendations for further work at the site. Section 9 lists the references used to develop this document. Appendix A contains borehole logs, monitoring well construction diagrams, slug test results, and survey data. Appendix B presents previous analytical and unpublished data used in the preparation of this report. Appendix C presents soil, sediment, groundwater, and surface water analytical results collected as part of this TS. Appendix D contains Bioscreen model input parameters, model output, figures of model output, and calculations related to model calibration. Appendix E contains Bioscreen model input and output for use in a Microsoft® Excel spreadsheet environment. Appendix F contains calculations for remedial option design and costing.

1.3 INSTALLATION DESCRIPTION AND HISTORY

Eaker AFB is located in the northeastern corner of Arkansas, in Mississippi County, approximately 3 miles south of the Missouri state line and 11 miles west of the Tennessee state line. The Base occupies an area of approximately 3,300 acres 2 miles northwest of Blytheville, Arkansas and adjacent to the community of Gosnell (Figure 1.1). The Base is divided roughly in half by the main north/south runway (Figure 1.2). Aviation support, approximately 930 Base housing units, a hospital, and commercial facilities are located in the western portion of the Base. The eastern half of the Base is dedicated primarily to agricultural, recreational, and industrial activities. The predominant existing land use surrounding Eaker AFB is agricultural, with some residential parcels (Eaker AFB, 1992).

The Base was established in 1942 as the Blytheville Army Airfield and served as a training center until deactivation in 1945. From 1947 to 1955, the site was used for manufacturing, for private housing, and as an airport. The Base was reactivated as Blytheville AFB in 1955 under the direction of the Tactical Air Command, and then transferred to the Strategic Air Command (SAC) in 1958. The 97th Bombardment Wing assumed command of the Base until the disestablishment of SAC in 1992, when control was transferred to the Air Combat Command. In 1988, the Base was renamed Eaker

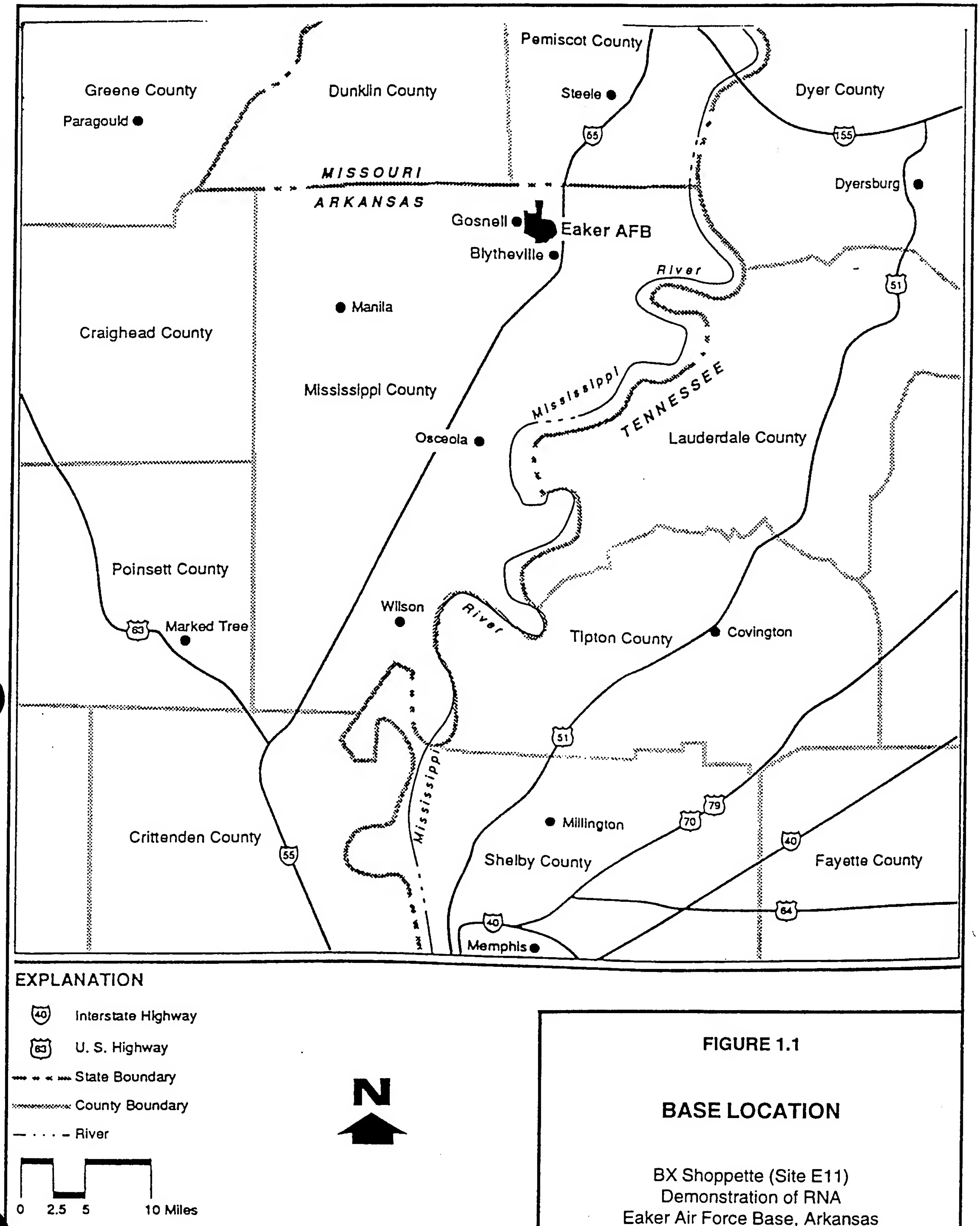


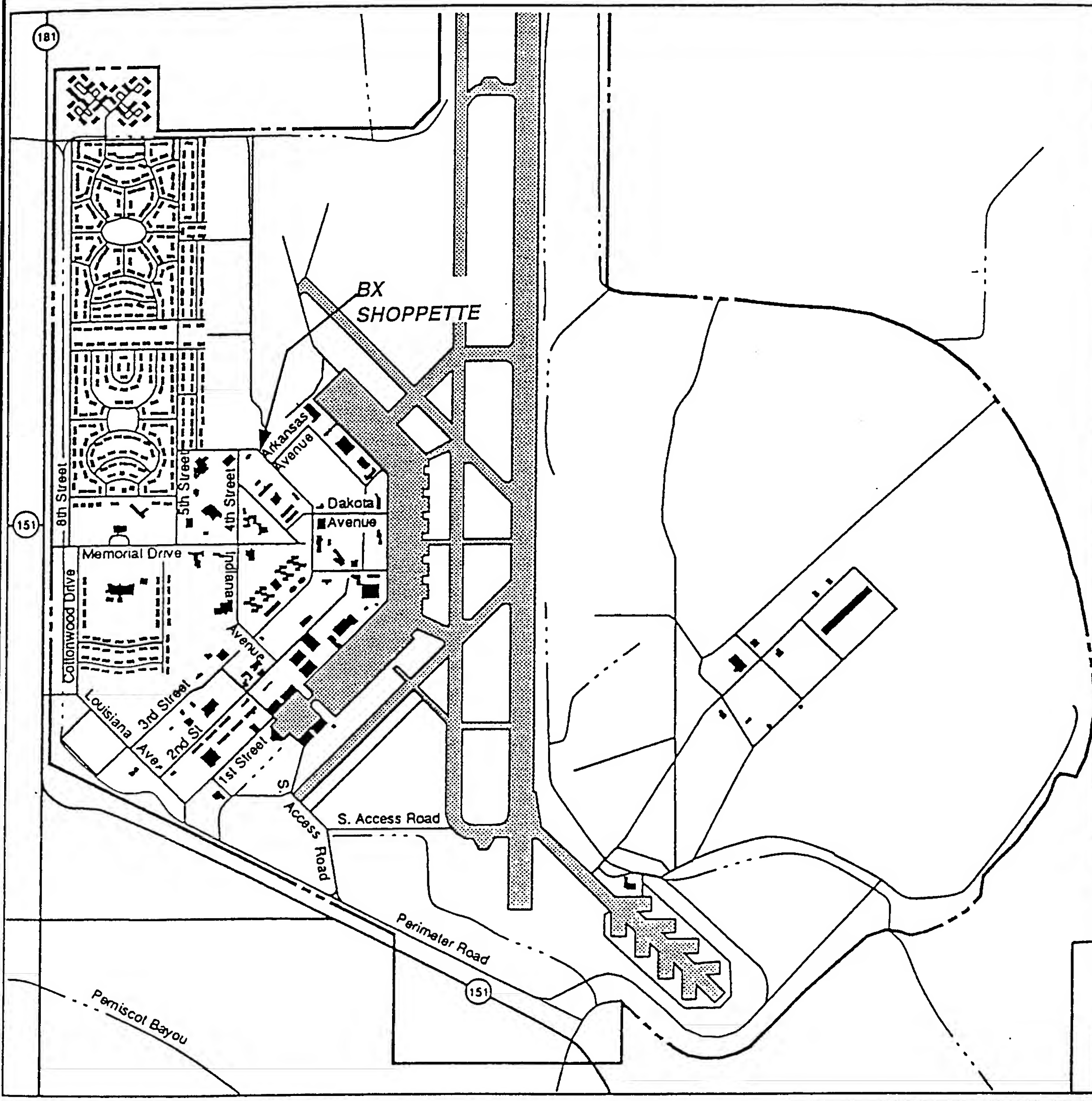
FIGURE 1.1

BASE LOCATION

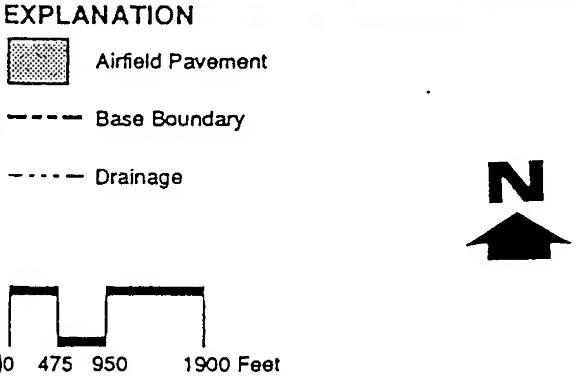
BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

Sources: Eaker AFB, 1992.



EXPLANATION



Sources: Eaker AFB, 1992.

FIGURE 1.2

BX SHOPPETTE LOCATION

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

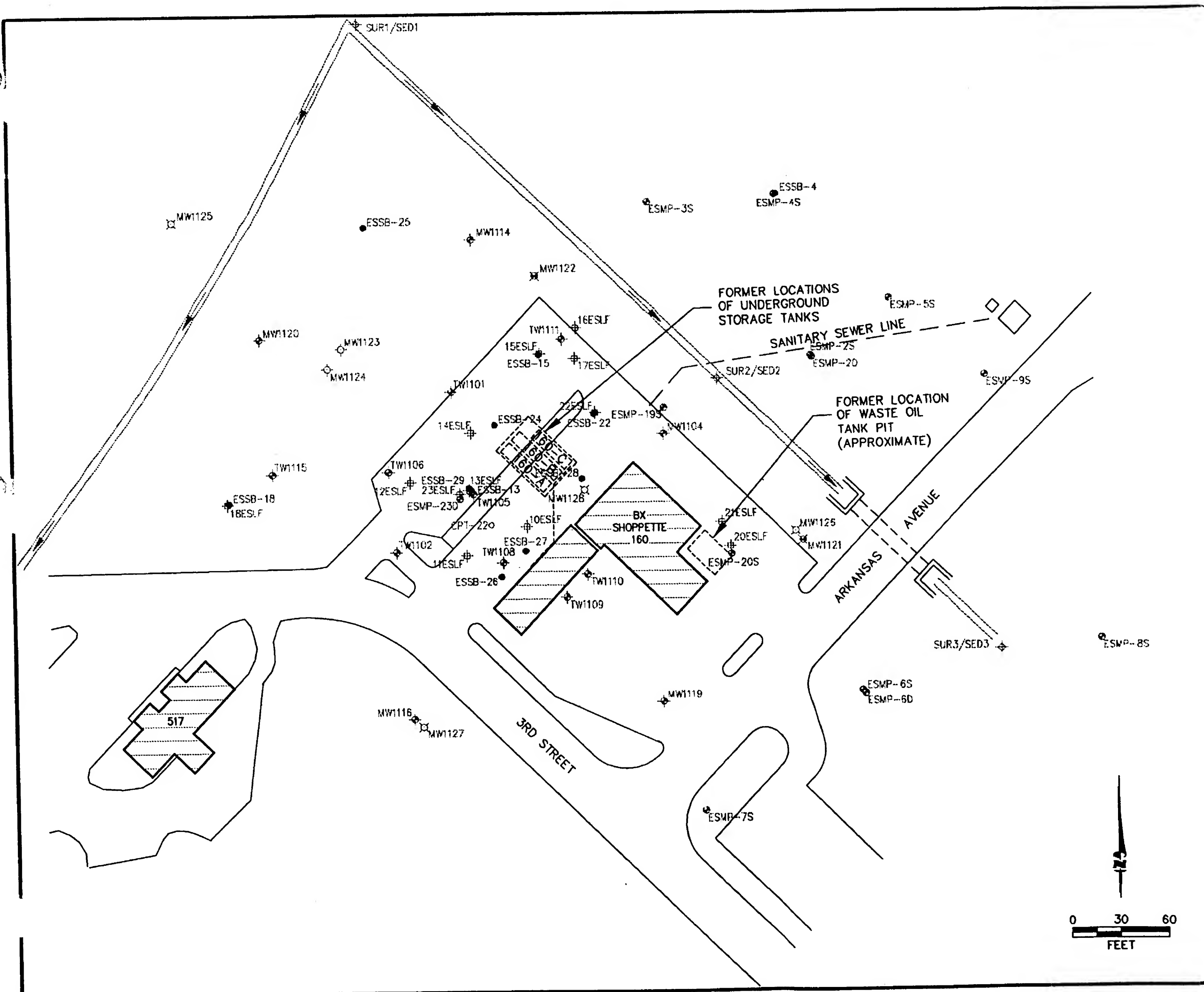
AFB. Base operations in 1990 employed approximately 3,600 civilian and military personnel (Eaker AFB, 1992). In July 1991, the recommendation for base closure was approved, and closure commenced in December, 1992.

1.4 SITE BACKGROUND

The BX Shoppette site is located in the west-central portion of the Base (Figure 1.2) and is bounded by undeveloped land to the north and west, and by Base operations facilities to the east and south. Two 10,000-gallon underground storage tanks (USTs) were installed at the site in 1969. The tanks (160-A and 160-B) were steel-constructed, tar-coated, and corrosion protected with sacrificial anodes (cathodic protection). Two additional USTs (160-C and 160-D) were installed in 1971. Tank 160-C, with a capacity of 6,000 gallons, also was steel-constructed, tar-coated, and cathodically protected. Tanks 160-A through 160-C originally contained regular leaded gasoline; however, the tanks were converted from leaded to unleaded gasoline in 1988 (Looney, 1996). Tanks 160-A, -B, and -C were buried in a pit located approximately 30 feet northwest of the BX Shoppette (Figure 1.3). Tank 160-D, a 550-gallon tank used to store waste oil, was located at the eastern corner of the shoppette building (Figure 1.3). This tank is constructed of steel but was not cathodically protected (Halliburton NUS, 1994).

In 1974, a leak in the pipeline from the fuel USTs to the fuel dispensers was repaired. An unknown amount fuel was released prior to repair of the 1974 pipeline leak, and no hydrocarbon-contaminated soils were removed during the repair (Halliburton NUS, 1992). In December 1989, a tank tightness test was performed on the BX Shoppette USTs. Tank 160-A failed the tightness test and was subsequently deactivated in March 1990. In August 1990, a tank and line tightness test was performed on the remaining USTs and fuel dispensing system. This test identified leaks in Tank 160-B, Tank 160-C, and Tank 160-D. The tops of the tanks were exposed and isolated from their associated piping for retesting. All three tanks passed the retesting, suggesting that leaks were present in the fuel transfer lines.

In February and June 1991, a total of 28 soil borings were installed by Professional Services, Inc. (PSI) (Halliburton NUS, 1992). The horizontal limits of soil benzene, toluene, ethylbenzene, and xylenes (BTEX) contamination were established around the gasoline tank pit and associated transfer lines; however, the vertical extent of soil BTEX



LEGEND

- MW1120 — MONITORING WELL, INSTALLED DECEMBER 1991–JANUARY 1992
- MW1121 — MONITORING WELL, INSTALLED APRIL 1995
- MW1123 — MONITORING WELL, INSTALLED AUGUST 1995
- MW1126 — MONITORING WELL, INSTALLED OCTOBER 1995–NOVEMBER 1995
- ESMP-25 — MONITORING POINT, INSTALLED MARCH 1996
- ESSB-18 — SOIL BORING, MARCH 1996
- 18ESLF — CONE PENETROMETER/LASER INDUCED FLUORESCENCE (CPT/LIF) LOCATION, MARCH 1996
- SUR1/SED1 — SURFACE WATER (SUR) OR SEDIMENT (SED) SAMPLING LOCATION, MARCH 1996
- MONITORING WELL, INSTALLATION DATE UNKNOWN

Bele — rna. doc.

FIGURE 1.3

SITE MAP

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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was not fully defined. BTEX compounds were detected in soil samples from 22 feet below ground surface (bgs) between the fuel tank pit and the BX Shoppette (Figure 1.3).

Site investigations continued between 1992 and 1995 under the Installation Restoration Program (IRP) and involved soil sampling, monitoring well installation, and groundwater sampling (Halliburton NUS, 1992, 1994, and 1995). In May 1992, mobile LNAPL was measured at a thickness of over 4 feet at monitoring well TW-1105 which is located southwest of the gasoline tank pit. Groundwater contamination was discovered during these site characterization events and was predicted to be migrating with groundwater flow to the west/northwest or the east/northeast, depending on the season. Groundwater may be preferentially migrating laterally along thin layers of silt and sand between clay layers. The four site USTs were removed in September 1995 along with approximately 600 cubic yards of tank pit soils (R&R International, Inc., 1996). Information is unavailable regarding the depth of the tank pit excavations or if groundwater was encountered.

Cone penetrometer/laser induced fluorescence (CPT/LIF) activities were conducted twice at the site prior to March 1996 to further delineate soil contamination and to develop CPT/LIF technology. The initial CPT/LIF effort, conducted by the US Army Corps of Engineers (USACE, 1995a), occurred in March 1995 and consisted of subsurface scans for free and residual fuel hydrocarbons with a nitrogen LIF probe. The second CPT/LIF characterization event occurred in October 1995 and involved scanning for free and residual hydrocarbons with a tunable LIF probe (USACE, 1995b). Soil samples were collected and analyzed for petroleum hydrocarbons during the second CPT/LIF site characterization event in an attempt to correlate tunable LIF probe readings with site analytical data.

In February 1992, Eaker AFB personnel bailed a total of 10.75 gallons of free product from monitoring well TW-1105. In September 1996, an AFCEE-sponsored bioslurper demonstration project was initiated using existing wells in the source area at the BX Shoppette (Brannon, 1996). Approximately 250 gallons of free product were recovered from the site during September and October 1996.

The results of previous site investigations are presented in the following reports:

- Site Assessment Report for the BX Shoppette (PSI, Inc., 1991);

- IRP Draft Site Assessment Report for the BX Shoppette Underground Storage Tank Site, Eaker AFB, Arkansas (Halliburton NUS, 1992);
- Final Environmental Impact Statement, Disposal and Reuse of Eaker Air Force Base, Arkansas (Eaker AFB, 1992);
- Unpublished BX Shoppette Site Data, Eaker AFB, Arkansas (Halliburton NUS, 1994)
- Unpublished Site Characterization and Analysis Penetrometer System (SCAPS), March 1995 (USACE, 1995a)
- Unpublished SCAPS Data, October 1995 (USACE, 1995b)
- Unpublished BX Shoppette Site Data, Eaker AFB, Arkansas (Halliburton NUS, 1995)
- UST/OWS Report for Eaker AFB, Arkansas (R&R International, Inc., 1996); and
- IRP Final Site Assessment Report for the BX Shoppette (Halliburton NUS, 1996).

The site-specific data presented in Sections 3, 4, and 5 are based on a review of these documents and on data collected by Parsons ES under this program in March 1996.

SECTION 2

SITE CHARACTERIZATION ACTIVITIES

This section summarizes the methods used by Parsons ES to collect site-specific data at the Base. These methods are more fully described in the work plan (Parsons ES, 1996). To meet the requirements of the RNA demonstration, additional data were required to evaluate near-surface geology, aquifer properties, and the nature and extent of soil and groundwater contamination. Site characterization activities included subsurface exploration with CPT/LIF; sampling and analyzing soils from CPT pushes; soil coring with a Geoprobe® apparatus; sampling and analyzing soils from Geoprobe® pushes; installing permanent and temporary groundwater monitoring points; sampling and analyzing groundwater from monitoring points and monitoring wells; collecting and analyzing surface water and sediment samples; and measuring or estimating hydrogeologic parameters (static groundwater levels, groundwater gradient, groundwater flow direction, and hydraulic conductivity). These investigation activities were used to collect the following physical and chemical hydrogeologic data:

- Depth from measurement datum to the water table or potentiometric surface in monitoring wells and points;
- Rate of change of water elevation following rapid depression or elevation of water level in a monitoring well;
- Location of potential groundwater recharge and discharge areas;
- Stratigraphy of subsurface media;
- Extent of residual petroleum hydrocarbon contamination in soils;
- Concentrations of dissolved oxygen (DO), nitrate, nitrite, manganese, ferrous iron, sulfate, methane, chloride, carbon dioxide, ammonia, and total organic carbon (TOC) in groundwater;
- Temperature, specific conductance, reduction/oxidation (redox) potential, total alkalinity, and pH of groundwater;

- Concentrations of BTEX, chlorobenzene, trimethylbenzene (TMB), tetramethylbenzene (TEMB), and total volatile hydrocarbons in groundwater and soil samples;
- Concentrations of BTEX in surface water and sediment samples; and
- TOC in soil samples.

In addition to the work conducted under this program, complementary site characterization data were previously collected by PSI (1991) and Halliburton NUS (1992, 1994, and 1995) and USACE (1995a and 1995b). Activities included the installation and sampling of soil samples, installation and sampling of soil borings, installation and sampling of monitoring wells, static groundwater level measurement, site stratigraphy analysis, and delineation of the extent of contamination in the vadose zone. Previously collected data and data collected under this program were integrated to develop the conceptual site model and to aid with interpretation of the physical setting (Section 3) and contaminant distribution (Section 4).

The remainder of Section 2 describes the procedures followed during the field work phase of the RNA demonstration. Additional details regarding investigative activities are presented in the draft work plan (Parsons ES, 1996).

2.1 CONE PENETROMETRY

Subsurface conditions at the site were evaluated using CPT coupled with LIF from March 26 through 28, 1996. CPT pushes were performed at 22 locations for monitoring point installation to evaluate the extent of residual or mobile LNAPL in soils. Eleven of the 22 CPT push locations were performed to collect site stratigraphy data needed to optimize the placement of screened intervals for monitoring points (locations ESMP-2 through ESMP-9, ESMP-19, ESMP-20, and ESMP-23) and to monitor for potential soil contamination. Eleven CPT push locations were performed to evaluate site stratigraphy and to identify potential soil contamination (ESLF-10 through ESLF-18, ESLF-20 and ESLF-21). The CPT truck was used to collect five soil samples. All subsurface utility lines, man-made subsurface features, and proposed monitoring point locations were cleared or approved by the Base prior to any CPT/LIF activities.

2.1.1 Determination of Stratigraphy

Cone penetrometry is an expeditious and effective means of analyzing the stratigraphy of a site by measuring the resistance against the conical probe of the penetrometer as it is pushed into the subsurface. Stratigraphy is determined from a correlation of the point stress at the probe tip and frictional stress on the side of the cone. Stratigraphy as determined from the CPT is checked against previous soil data or to soil samples collected to correlate the CPT readings to the lithologies present at the site. Methodologies for the collection of soil samples are described in Section 2.1.3.

CPT was conducted using the USACE cone penetrometer truck. This equipment consists of an instrumented probe that is forced into the ground using a hydraulic load frame mounted on a heavy truck, with the weight of the truck providing the necessary reaction mass. The penetrometer equipment is housed in a stainless steel, dual-compartment body mounted on a 43,000-pound, triple-axle Kenworth® truck chassis powered by a turbo-charged diesel engine. The weight of the truck and equipment is used as ballast to achieve the overall push capability of 39,000 pounds. This push capacity may be limited in tight soils by the structural bending capacity of the 1.8-inch outside-diameter (OD) push rods, rather than by the weight of the truck. The current 39,000-pound limitation is intended to minimize the possibility of push-rod buckling. Penetration force is supplied by a pair of large hydraulic cylinders bolted to the truck frame. The penetrometer is usually advanced vertically into the soil at a constant rate of 2 centimeters per second (cm/s), although this rate must sometimes be reduced, such as when hard layers are encountered.

The penetrometer probe is of standard dimensions, having a 1.8-inch OD, 60-degree conical point with sacrificial tip, and an 8.0-inch-long by 1.8-inch-OD friction sleeve. Inside the probe, two load cells independently measure the vertical resistance against the conical tip and the side friction along the sleeve. Each load cell is a cylinder of uniform cross-section which is instrumented with four strain gauges in a full-bridge circuit. Forces are sensed by the load cells, and the data are transmitted from the probe assembly via a cable running through the push tubes. The analog data are digitized, recorded, and plotted by computer in the penetrometry truck. A grout tube also runs down the push cylinder to allow the introduction of cement grout into the hole as the probe is withdrawn in order to seal the CPT hole.

2.1.2 Investigation of Residual and Mobile Hydrocarbons

The known propensity of aromatic hydrocarbons to fluoresce under ultraviolet wavelengths has allowed the use of LIF technology, in conjunction with CPT technology, to evaluate soil characteristics and hydrocarbon contamination simultaneously. The LIF system has a 0.25-inch sapphire window in the side of the cone that allows a nitrogen laser to scan the soil for fluorescent compounds as the LIF penetrometer rod pushes through soil. Assuming that aromatic hydrocarbons are simultaneously solvenated with other fuel-hydrocarbon constituents, the magnitude of aromatic fluorescence is indicative of hydrocarbon contamination in a soil matrix. Fiber optic cables connected to the laser spectrometer and a 6-pair electrical conductor connected to the CPT data acquisition system, are routed through the interior of the push tubes to the CPT probe.

The basic components of the LIF instrument are a laser, a fiber optic probe, a monochromator for wavelength resolution of the return fluorescence, a photomultiplier tube to convert photons into an electrical signal, a digital oscilloscope for waveform capture, and a control computer. The fiber optic probe for the cone penetrometer consists of delivery and collection optical fibers, a protective sheath, a fiber optic mount within the cone, and a 0.25-inch sapphire window. The wavelength used in the USACE CPT/LIF system gives the strongest fluorescence signal (attributable to the presence of contamination) for naphthalene and heavier, long-chained hydrocarbons. Thus, while the LIF is not entirely appropriate for detecting the fluorescence of BTEX, it is useful for defining soil contamination because the heavy long-chained hydrocarbons that are most likely to sorb to the soil matrix than the more soluble BTEX compounds.

Graphical results of each CPT/LIF push were plotted by USACE staff at the conclusion of each penetration and were available minutes after the completion of each hole. The graphs showed cone resistance, sleeve friction, soil classification, fluorescence intensity, and maximum fluoresced wavelength. The real-time availability of the CPT information allowed the Parsons ES field scientist to make investigative decisions based on the most current information. Final CPT logs are presented in Appendix A.

2.1.3 Soil Sample Collection

The CPT was used to collect five soil samples for analysis of TOC, BTEX, TMBs, and TEMB on March 28, 1996 (Figure 2.1). The samples were collected at locations

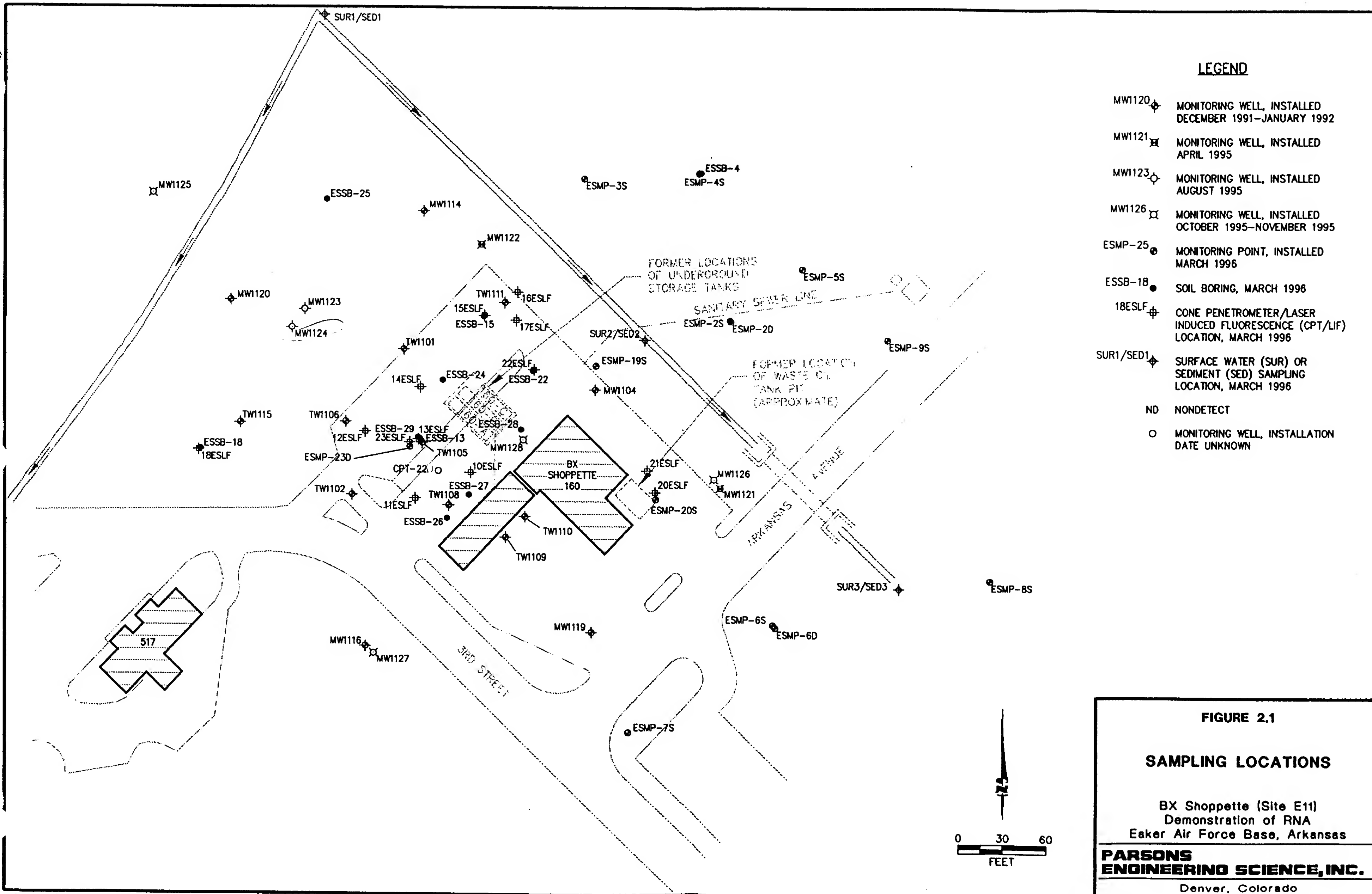

FIGURE 2.1

SAMPLING LOCATIONS

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

K:\AFCEE\722450\96DN1254, 12/30/96 at 10:37

ESSB-4, ESSB-13, ESSB-15, ESSB-18, and ESSB-22. The sample were collected just above the water table from silty clay and sandy intervals from 7.0 to 10.5 feet bgs.

The samples were collected using a Hoggen-Toggler® sampling device, which can be used to collect undisturbed soil samples at any desired depth within the range of the driving apparatus. The sampler is coupled to the penetrometer rod and pushed into the soil with the CPT truck. With the Hoggen-Toggler® cone in the closed position, soil is prevented from entering the sampling tube until the desired depth is achieved. When the sampler has been pushed to the depth at which the soil sample is to be taken, the sampling unit is raised a few inches and the Hoggen-Toggler® apparatus is opened. The open Hoggen-Toggler® is pushed to fill with soil, then pulled from the ground as quickly as possible. The Hoggen-Toggler® sampling apparatus allows collection of 8-inch-long by 1-inch inside-diameter (ID) continuous samples.

The soil samples collected using the Hoggen-Toggler® assembly were placed in clean, 4-ounce glass jars, packed with bubble wrap, and cooled to 4 degrees Celsius (°C) in an insulated cooler. For each sample, the Parsons ES field scientist recorded the following information:

- Sample interval (top and bottom depth);
- Presence or absence of contamination;
- Lithologic description, including major textural constituents, minor constituents porosity, color, relative moisture content, plasticity of fines, cohesiveness, grain size, structure or stratification, and any other significant observations; and
- Any unusual conditions.

A summary of the chemical analyses performed for soil samples is presented in Table 2.1.

2.1.4 CPT Hole Abandonment

The CPT/LIF probe is equipped with a grout tube and sacrificial tip; therefore, the CPT/LIF holes not completed to monitoring points were abandoned with a Portland® cement grout as the CPT pushrod was withdrawn. Collection of samples with the Hoggen-Toggler® sampler did not allow for grouting during pushrod withdrawal;

TABLE 2.1
ANALYTICAL PROTOCOL FOR GROUNDWATER, SURFACE WATER, SOIL, AND SEDIMENT SAMPLES
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

MATRIX	METHOD	ANALYTICAL LABORATORY
WATER		
Total Iron	Colorimetric, Hach Method 8008	Field
Ferrous Iron (Fe+2)	Colorimetric, Hach Method 8146	Field
Ferric Iron (Fe+3)	Difference between total and ferrous iron	Field
Manganese	Colorimetric, Hach Method 8034	Field
Sulfide	Colorimetric, Hach Method 8131	Field
Sulfate	E300 or SW9056	Evergreen[a/]
Nitrate	Titrimetric, Hach Method 8039 and 8192	Field
Nitrate	E300 or SW9056	Evergreen
Nitrite	Titrimetric, Hach Method 8040	Field
Nitrite	E300 or SW9056	Evergreen
Redox Potential	A2580B, direct reading meter	Field
Oxygen	Direct reading meter	Field
pH	Direct reading meter	Field
Conductivity	Direct reading meter	Field
Temperature	Direct reading meter	Field
Alkalinity (Carbonate [CO3-2] and Bicarbonate [HCO3-1])	Titrimetric, Hach Method 8221	Field
Carbon Dioxide	CHEMetrics Method 4500	Field
Chloride	Hach Model 8P	Field
Chloride	E300 or SW9056	Evergreen
Ammonia--Diss. Gas in Water	CHEMetrics Method 4500	Field
Alkalinity	310.1	Evergreen
Methane	RSKSOP175	Evergreen
Total Organic Carbon	EPA 415.1	Evergreen
Aromatic Hydrocarbons (Including Trimethylbenzenes and Tetramethylbenzene)	SW8020	Evergreen
Total Volatile Petroleum Hydrocarbons	SW8015, modified (Gasoline)	Evergreen
FREE PRODUCT		
Aromatic Hydrocarbons	SW8020	Evergreen
SURFACE WATER		
Aromatic Hydrocarbons	SW8020	Evergreen
SOIL		
Total Organic Carbon	SW9060	Evergreen[b/]
Moisture	EPA 160.3	Evergreen
Aromatic Hydrocarbons	SW8020	Evergreen
Total Volatile Hydrocarbons	SW8015, modified	Evergreen
SEDIMENT		
Aromatic Hydrocarbons	SW8020	Evergreen

a/ Evergreen Analytical, Inc. of Wheat Ridge, Colorado.

b/ Subcontracted by Evergreen to Huffman Laboratories of Golden, Colorado.

therefore, these holes were abandoned with Portland® cement from the ground surface after sample collection.

2.1.5 Equipment Decontamination

After sampling at each CPT location, CPT push rods were cleaned with the CPT steam-cleaning system (rod cleaner) as the rods were withdrawn from the ground. A vacuum system located beneath the CPT truck was used to recover cleaning water. Use of this system resulted in nearly 100-percent recovery of steam-cleaning rinseate from the rod cleaner. Rinseate was generated only as the rods moved past the cleaner, thereby minimizing liquid waste generation.

All soil sampling tools were cleaned onsite with a steam/hot-water spray prior to use and between each sampling event. Precautions were taken to minimize any impact to the surrounding area that might result from decontamination operations. Potable water used in CPT equipment cleaning, decontamination, or grouting was obtained from the base water supply.

2.2 GEOPROBE®

Geoprobe®-related field work occurred on March 28, 1996, and consisted of soil sampling at push locations ESSB-13, ESSB-24, ESSB-25, ESSB-26, ESSB-27, ESSB-28, and ESSB-29 (Figure 2.1). Geoprobe® activities were performed in addition to those activities described in the work plan (Parsons ES, 1996) to expedite soil sampling at the site and to improve the efficiency of soil sample collection.

The Geoprobe® system is a truck-mounted, hydraulically powered percussion/probing machine used to advance sampling tools through unconsolidated soils. This system provides for the rapid collection of soil, soil gas, and groundwater samples at shallow depths while minimizing the generation of investigation-derived waste materials. All necessary clearances for subsurface sampling with the Geoprobe® were completed as described in Section 2.1.

2.2.1 Equipment Decontamination Procedures

Prior to arriving at the site, all probe rods, tips, sleeves, pushrods, samplers, tools, and other downhole equipment were decontaminated using an Alconox® detergent and potable water solution followed by a high-pressure potable water wash. All equipment

also underwent an additional rinse with isopropyl alcohol followed by a final rinse with deionized water.

2.2.2 Borehole Advancement and Soil Sampling

The Geoprobe®-collected soil samples were obtained using a probe-drive sampler. The probe-drive sampler serves as both the driving point and the sample collection device and is attached to the leading end of the probe rods. To collect a soil sample, the sampler was pushed or driven to the desired sampling depth, and the stop pin was removed, allowing the piston and drive point to retract as the sample barrel was pushed into undisturbed soil. The soil cores were retained within a clear acetate liner inside the sampling barrel. The probe rods were then retracted, bringing the sampling device to the surface. The soil sample was then cut from the liners, composited over 1-foot intervals, and transferred to analyte-appropriate jars supplied by the analytical laboratory. A portion of the sample was retained for visual logging and photoionization detector (PID) headspace screening for volatile organic compounds (VOCs). Remaining soil was used for lithologic and stratigraphic logging.

Bags containing soil samples collected for the headspace screening procedure were quickly sealed and stored for 15 minutes at the ambient temperature. Semiquantitative measurements were made by puncturing the bag seal with the PID probe and reading the concentration of the headspace gases. The PID relates the concentration of total VOCs in the sample to an isobutylene calibration standard. The PID was also used to monitor for VOCs in the worker breathing zone.

The Parsons ES field hydrogeologist observed CPT and Geoprobe® soil sampling and monitoring point installation activities with the CPT and maintained a descriptive log of subsurface materials recovered. Final geologic borehole logs are presented in Appendix A. These logs contain:

- Sampled interval (top and bottom depths);
- Presence or absence of contamination based on odor, staining, and/or PID readings;
- Soil description, including color, major textural constituents, minor constituents, relative moisture content, plasticity of fines, cohesiveness, grain size, structure or stratification, and any other significant observations; and,

- Lithologic contacts, with the depth of lithologic contacts and/or significant textural changes recorded to the nearest 0.1 foot.

The small volume of waste soils generated during monitoring point installation and sampling operations was spread on the ground surface in the vicinity of the site.

2.3 MONITORING POINT INSTALLATION

Using the CPT truck, USACE staff installed 13 0.5-inch-ID monitoring points at 11 locations in the vicinity of the BX Service Station (Figure 2.1). Ten shallow monitoring points (ESMP-2S, -3S, -4S, -5S, -6S, -7S, -8S, -9S, -19S, and -20S) were installed north and east of the BX Service Station in saturated silty-clay soils below and across the water table. At two of these locations, ESMP-2 (ESMP-2S and -2D) and ESMP-6 (ESMP-6S and -6D), a deep monitoring point was clustered with the shallow point. A third deep monitoring point (ESMP-23D) was installed in a cluster with source area monitoring well TW-1105. The deep monitoring points were screened at the top of the deep sandy layer approximately 15 feet below the water table. The deep monitoring point clustered with TW-1105 was abandoned by filling the pushhole with grout because an effective annular seal could not be placed to prevent potential downward migration of mobile LNAPL into deeper saturated sands. Monitoring point ESMP-20S produced insufficient volumes of groundwater and was abandoned after initial groundwater sampling.

All monitoring points were assigned a three-part identifier. The first part is "ESMP" which designates the object as a Parsons Engineering Science monitoring point. The second part of the name is a number which corresponds the CPT/LIF location number. The third part is a letter which identifies the relative location of the screened interval with the water table: the letter "S" is used for monitoring points screened in silty clays of the surficial aquifer; the letter "D" is used for monitoring points screened in sandy soils below the clay layer separating the surface aquifer from the sandy aquifer below. The locations of all installed monitoring points are shown on Figure 2.1. A summary of monitoring point construction details (including construction details of existing monitoring wells) is provided in Table 2.2. Monitoring point completion diagrams are provided in Appendix A.

2.3.1 Materials

Monitoring points were constructed of flush-threaded 0.5-inch-ID/0.75-inch-OD polyvinyl chloride (PVC) casing and screen. Installed screens were 3.3 feet in length and

TABLE 2.2
MONITORING POINT/WELL CONSTRUCTION DETAILS AND SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS
BX SHOPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Well Location	Installation Date	Northing (feet)	Easting (feet)	Well ID (inches)	Datum Elevation (ft msl)[a/]	Ground Elevation (ft msl)	Screen Interval Top (ft bgs)[b/]	Screen Interval Bottom (ft bgs)
ESMP-2S	3/27/96	599433.23	2605219.08	0.5	251.62	251.47	8.4	11.7
ESMP-2D	3/27/96	599432.28	2605219.72	0.5	251.65	251.47	29.1	32.4
ESMP-3S	3/27/96	599538.88	2605107.12	0.5	251.36	251.56	7.7	11.0
ESMP-4S	3/27/96	599543.34	2605194.96	0.5	252.04	252.08	8.4	11.7
ESMP-5S	3/27/96	599471.44	2605273.69	0.5	251.22	251.25	9.6	12.8
ESMP-6S	3/27/96	599204.77	2605252.01	0.5	249.41	249.55	10.6	13.9
ESMP-6D	3/27/96	599202.63	2605253.95	0.5	249.35	249.55	27.4	30.7
ESMP-7S	3/26/96	599123.74	2605141.50	0.5	249.27	249.26	8.6	11.9
ESMP-8S	3/26/96	599238.12	2605417.29	0.5	251.41	251.48	8.4	11.7
ESMP-9S	3/27/96	599418.91	2605339.00	0.5	248.83	248.94	6.3	9.6
ESMP-19S	3/28/96	599398.85	2605116.62	0.5	251.21	251.19	10.0	13.2
ESMP-20S	3/28/96	599298.62	2605162.27	0.5	NA[c/]	248.97	6.5	9.8
ESMP-23D[d/]	3/28/96	599337.51	2604974.83	0.5	NA	249.97	NA	NA
CPT-22	NA	599319.43	2604996.46	2	249.12	249.34	NA	16.0
TW-1101	12/11/91	599410.72	2604970.12	2	250.48	250.61	15.2	25.2
TW-1102	12/11/91	599301.35	2604930.41	2	248.47	248.67	12.4	22.6
MW-1104	12/11/91	599381.05	2605116.10	2	250.45	250.63	14.1	24.1
TW-1105	12/13/91	599340.65	2604984.33	2	250.12	250.31	13.4	23.4
TW-1106	12/13/91	599356.27	2604925.71	2	249.92	250.12	13.5	23.7
TW-1109	12/14/91	599269.94	2605047.82	2	249.84	250.03	8.2	18.2
TW-1110	12/14/91	599285.49	2605062.49	2	250.21	250.35	8.2	18.2
TW-1111	12/15/91	599446.02	2605047.07	2	250.31	250.43	8.1	18.1
MW-1114	12/16/91	599513.94	2604985.04	2	250.62	250.80	6.2	16.4
TW-1115	12/16/91	599355.32	2604845.79	2	249.35	249.53	6.2	16.3
MW-1116	12/16/91	599187.57	2604940.78	2	249.55	249.89	7.9	18.0
MW-1119	12/17/91	599198.74	2605113.41	2	248.64	248.86	5.0	15.0
MW-1120	1/7/92	599447.45	2604838.22	2	250.70	250.85	17.2	27.2
MW-1121	4/8/95	599307.39	2605212.01	2	252.24	249.86	4.2	14.2
MW-1122	4/7/95	599488.96	2605029.03	2	252.19	249.70	5.1	15.1
MW-1123	8/11/95	599426.89	2604884.87	2	252.72	250.33	7.0	17.0
MW-1124	8/12/95	599440.61	2604894.42	2	253.13	250.53	26.0	36.0
MW-1125	10/31/95	599527.42	2604778.67	2	252.64	249.57	26.0	36.0
MW-1126	11/1/95	599313.82	2605207.19	2	252.80	250.01	29.0	39.0
MW-1127	11/3/95	599182.29	2604946.92	2	249.72	249.90	24.5	34.5
MW-1128	11/5/95	599343.01	2605061.21	2	250.11	250.35	28.0	38.0
SED1[e/]	3/29/96	599661.32	2604902.68	-[f/]	-	242.14	-	-
SED2	3/29/96	599419:43	2605155.65	-	-	242.06	-	-
SED3	3/29/96	599233.72	2605349.21	-	-	241.79	-	-
SUR1[g/]	3/29/96	599661.32	2604902.68	-	-	242.92	-	-
SUR2	3/29/96	599419.43	2605155.65	-	-	242.82	-	-
SUR3	3/29/96	599233.72	2605349.21	-	-	242.79	-	-

a/ ft msl = feet above mean sea level.

b/ ft bgs=feet below ground surface.

c/ NA = Not available.

d/ ESMP-23D was abandoned before completion.

e/ SED1 = Sediment sampling location 1.

f/ "-"=Not applicable.

g/ SUR1 = Surface water sampling location 1.

Note: Temporary wells TW-1103, TW-1107, TW-1108, TW-1112, TW-1113, TW-1117, and TW-1118 were completely or partially abandoned or removed.

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factory-slotted with 0.010-inch openings. A sacrificial stainless steel CPT tip was screwed into the PVC screen and served as the bottom cap of the monitoring point. Each monitoring point was fitted with a PVC top cap upon completion. Point construction materials were inspected for cleanliness prior to use. No glue or solvents were used with monitoring point materials.

2.3.2 Installation

Monitoring points were pressed into the ground through the inside of 1.8-inch-OD CPT pushrods. This method protects the monitoring point screen and casing until the monitoring point has been placed at the desired depth and the pushrods are removed. To accomplish this, the PVC screen was threaded through the bottom CPT pushrod. A sacrificial tip was screwed into the bottom of the screen and pressed into the bottom of the CPT pushrod. As the pushrod was pressed into the ground, CPT pushrods and new PVC casing were continuously attached until the desired depth was reached. Upon removal of the pushrods, a fully-cased monitoring point remained. Data collection devices such as CPT and LIF could not be used during monitoring point placement; however, CPT was performed prior to monitoring point installation in order to select screen depth intervals.

2.3.3 Development

Prior to sampling, newly installed monitoring points were developed. Typically, well development removes sediment from inside the well casing and flushes fines, cuttings, and drilling fluids from the sand pack and the portion of the formation adjacent to the well screen; however, use of the CPT apparatus to place monitoring points minimizes the amount of fine sediment that might accumulate in the casing.

Monitoring point development was accomplished using a peristaltic pump with new dedicated or decontaminated (Section 2.4.1.1) high-density polyethylene (HDPE) tubing. The pump tubing was regularly lowered to the bottom of the well so that fines were agitated and removed from the well in the development water. Where possible, development was continued until a minimum of 10 casing volumes of water was removed from the monitoring point. When a constant flow of groundwater could be obtained from a monitoring point, development was continued until the groundwater was relatively free of fine sediments and temperature, DO, and redox potential readings had stabilized.

Monitoring points ESMP-4S, ESMP-5S, ESMP-6S, ESMP-7S, and ESMP-20S were purged dry prior to removing 10 casing volumes of water. Purging of these points was continued over the next 24 hours until the full 10 volumes of water was extracted.

All groundwater derived from purging was collected in 3-gallon buckets and then transferred to 30-gallon barrels. After a barrel was filled, the headspace in the barrel was measured with a PID. As directed by base personnel, barrels with a headspace VOC reading below 5 parts per million volume (ppmv) were released on site, and all containerized groundwater with a headspace VOC reading above 5 ppmv was added to soils at an adjacent soil landfarm located southeast of the site (southeast side of Arkansas Avenue).

2.3.4 At-Grade Completion

Eleven monitoring points were completed with at-grade protective covers with the concrete sloped gently away from the protective casing to facilitate runoff during precipitation. Because the points were finished at grade, the monitoring point top caps were not vented. Monitoring points ESMP-20S and ESMP-23D were abandoned prior to completion with at-grade protective covers. The abandoned monitoring points were filled with bentonite grout to interrupt potential groundwater pathways.

2.4 GROUNDWATER SAMPLING

Groundwater samples were collected at 20 site monitoring wells and 13 newly installed monitoring points (Figure 2.1). Groundwater samples were analyzed by Parsons ES personnel in the field for alkalinity, DO, ferrous iron, free carbon dioxide, pH, phenols, redox potential, nitrate and nitrite, soluble manganese, sulfides, and temperature. Analyses for alkalinity, ammonia, chloride, methane, mobile LNAPL, nitrate and nitrite, sulfate, TOC, volatile chlorinated hydrocarbons were performed at EAL. Samples of mobile LNAPL hydrocarbons were collected from monitoring wells TW-1105 and TW-1108. The product samples were analyzed by EAL for the mass fraction of BTEX and TMBs and fuel density. Groundwater sampling forms were used to document the specific details of the sampling event for each well and monitoring point and are included in Appendix C.

This section describes the procedures used for collecting groundwater samples. In order to maintain a high degree of quality control (QC) during this sampling event, the

procedures described in the site work plan (Parsons ES, 1996) and summarized in the following sections were followed.

2.4.1 Preparation for Sampling

All equipment used for sampling was assembled and properly cleaned and calibrated (if required) prior to arriving in the field. Special care was taken to prevent contamination of the groundwater and extracted samples from improperly cleaned equipment; therefore, all reusable equipment was thoroughly cleaned before and after field use and between uses at different sampling locations.

2.4.1.1 Equipment Decontamination

All portions of sampling and test equipment that contacted the sample were thoroughly cleaned before use. The pump tubing, oil/water interface probe, and water level indicator were the only reusable pieces of equipment that came into contact with groundwater samples or were used downhole. The following protocol was used to clean the water level indicator and oil/water interface probe:

- Wiped/rinsed with isopropanol;
- Wiped/rinsed with deionized water; and
- Air dried prior to use.

Generally, cleaning of the HDPE tubing used with the peristaltic pump was not required because a new length of tubing was dedicated to the well or monitoring point; however, when the HDPE tubing was reused, it was cleaned inside and out with acetone and rinsed with deionized water. Decontaminated tubing was dedicated to a particular monitoring point for development, purging, and sampling so that by the time sampling occurred, a large volume of groundwater had passed through the tubing. Any deviations from these procedures were documented on the groundwater sampling form.

All cleaning fluids were contained and transferred to 30-gallon drums. The contents of these drums were disposed of by the method described in Section 2.3.3.

2.4.1.2 Equipment Calibration

Field analytical equipment was calibrated according to the manufacturers' specifications prior to field use, and as required. This requirement applied specifically to

the model 55 Yellow Springs Instrument (YSI) DO meter and the model 250A Orion pH, redox, and temperature meters, and the Exotech Oyster conductivity meter.

2.4.1.3 Preparation of Location

Prior to proceeding with sampling, the area around the well or monitoring point was cleared of foreign materials, such as brush, rocks, and debris to prevent sampling equipment from inadvertently contacting debris around the monitoring well. Location preparation also included an inspection of the integrity of the well or monitoring point. At this time irregularities with the protective cover, cap, lock, external surface seal, internal surface seal, well identification, well datum, or pad were noted.

2.4.1.4 Water Level and Total Depth Measurements

Prior to removing any water from the well/point, the static water level was measured. An electronic water level probe was used to measure the depth to groundwater below the well/monitoring point datum to the nearest 0.01 foot. If fuel was floating on the groundwater table, the fuel/air and fuel/water interfaces were measured with an oil/water meter. After measurement of the static water level, the water level probe or oil/water meter were lowered to the bottom of the well/point for measurement of total depth (recorded to the nearest 0.01 foot). Based on these measurements, the volume of water to be purged was calculated.

Static groundwater levels also were measured on March 30, 1996 at the conclusion of the field activities. Measurements were obtained at all permanent site wells and monitoring points.

2.4.2 Purging and Sample Collection

Well/monitoring point purging consisted of the removal of at least three casing volumes of water prior to sample collection. At all monitoring points the purge was completed using a peristaltic pump. At all monitoring well locations, disposable bailers were used for purging. Once three casing volumes of water was removed from the well or monitoring point, purging continued until the temperature and DO concentrations had stabilized, and if possible, until the purge water became clear.

A peristaltic pump with dedicated silicon and HDPE tubing was used to extract groundwater samples from each sampled well and monitoring point. Where possible,

purging and sampling constituted one continuous sampling event, and there was no cessation of pumping prior to sample collection. At three monitoring points (ESMP-2S, ESMP-6S, and ESMP-20S), groundwater volumes were purged dry before obtaining enough groundwater to perform all necessary analyses. These locations were sampled for a reduced suite of analyses within 24 hours of the original purge. For all monitoring points and wells, the dedicated HDPE tubing was lowered down the casing to approximately the middle of the screened interval. The samples were transferred directly into the appropriate sample containers. The water was carefully poured down the inner walls of each sample bottle to minimize aeration of the sample. Sample bottles for VOCs, TVH, and methane were filled so that there was no headspace or air bubbles within the container. Table 2.1 lists the analyses performed on collected groundwater samples.

All groundwater derived from purging and sampling was contained in 30-gallon covered containers. The content of these containers was disposed of by the method described in Section 2.3.3.

2.4.3 Onsite Chemical Parameter Measurement

DO measurements were taken using an Orion® model 840 or YSI-55 DO meter in a flow-through cell at the pump discharge tube. DO concentrations were recorded after the readings stabilized, and represent the lowest DO concentration observed.

Because the electrical conductivity, pH, redox potential, and temperature of the groundwater change significantly within a short time following sample acquisition, these parameters were measured in the field with an Orion® model 240A meter and an Exotech Oyster meter, in the same flow-through cell used for DO measurements. The measured values were recorded on the groundwater sampling record (Appendix C).

An onsite laboratory staffed by Parsons ES personnel was used to analyze for several indicator parameters in groundwater samples collected from pre-existing monitoring wells and newly installed monitoring points (Table 2.1). A Hach® DR/700 colorimeter was used to measure ferrous iron (Fe^{2+}), total iron (Fe), manganese (Mn^{2+}), and sulfide (S^{2-}). Titrations using Hach® reagents were conducted to measure alkalinity [as milligrams per liter (mg/L) calcium carbonate ($CaCO_3$)] and chloride (Cl^-); and CHEMetric® color tests were used to measure ammonia (NH_3) and carbon dioxide (CO_2).

These analyses were completed for each groundwater sample after all sample containers had been filled. The sample to be analyzed was poured into a clean glass container, capped, and transported to the Parsons ES on-Base laboratory for analysis. Special care was taken to avoid aerating the sample in the sample container, which could influence the concentration of reduced species. The field holding time for each sample did not exceed 1 hour. Care was taken to minimize sample temperature changes and exposure to sunlight. Concentrations of these indicator parameters were not measured in soil samples.

2.5 SURFACE WATER SAMPLING

Three surface water samples (SUR1 through SUR3) were collected from the northwest/southeast flowing drainage canal located northeast of the BX Shoppette (Figure 2.1). The samples were collected at locations upgradient from, within, and downgradient from the suspected area of groundwater contamination and potential groundwater seeps along the upgradient creek banks. The BTEX, TMB, TEMB, and chlorobenzene compounds were analyzed for in the surface water samples (Table 2.1).

Surface water samples were collected directly into the sample bottle by placing the sample bottle in the drainage canal with the opening facing up and allowing the water to slowly fill the bottle. Sample handling proceeded as described in Section 2.8.

2.6 SEDIMENT SAMPLING

Three sediment samples (SED1 through SED3) were collected from the bottom of the northwest/southeast flowing drainage canal at the same locations that surface water samples were collected (Figure 2.1). The samples were collected in order to assess the potential accumulation in drainage canal sediments of fuel contaminants that may have migrated from the BX Shoppette area. The BTEX, TMB, TEMB, and chlorobenzene compounds were analyzed for in the sediment samples (Table 2.1).

All sediment samples were collected from the uppermost 4 inches of the sediment column. The saturated sediments were immediately placed in analyte appropriate containers and handled according to procedures in Section 2.8.

2.7 FREE PRODUCT SAMPLING

Two mobile LNAPL (free product) samples were collected from monitoring wells TW-1105 and TW-1108. A peristaltic pump with dedicated HDPE tubing was used to extract the free product. The free product was carefully pumped into analyte-appropriate bottles. The product samples were carefully packaged, labeled, and cooled, and then sent to EAL for analysis. The BTEX, TMB, TEMB, and chlorobenzene compounds were analyzed for in the mobile LNAPL samples. Fuel density was also measured in the laboratory.

2.8 SAMPLE HANDLING

2.8.1 Sample Containers, Preservation, and Labels

The fixed-base analytical laboratory (EAL) provided pre-preserved sample containers where appropriate. The sample containers were filled as described in Sections 2.4.3, and the container lids were tightly closed. The sample label was firmly attached to the container side, and the following information was legibly and indelibly written on the label:

- Facility name;
- Sample identification;
- Requested analyses
- Sample type (e.g., groundwater, soil, sediment, or surface water);
- Sample Depth (soil samples only);
- Sampling date;
- Sampling time;
- Preservatives added; and
- Sample collector's initials.

2.2.5.2 Sample Shipment

After the samples were sealed and labeled, they were packaged for transport to EAL in Wheat Ridge, Colorado. The following packaging and labeling procedures were followed:

- Samples were packaged to prevent leakage or vaporization from the containers;
- Samples were cushioned to avoid breakage; and
- Ice was added to the cooler to keep the samples cool.

The packaged samples were delivered by overnight courier (Federal Express®) to the laboratory. Chain-of-custody procedures outlined in the project work plan (Parsons ES, 1996) were followed. Hach® laboratory samples were hand delivered to the on-Base Parsons ES laboratory.

2.9 AQUIFER TESTING

Slug tests were performed in wells MW-1104, MW-1116, MW-1119, MW-1121, MW-1123, MW-1124, MW-1125, MW-1126, and MW-1127 (Figure 2.1) to provide estimates for the hydraulic conductivity of the shallow and lower semi-confined aquifers in the vicinity of the BX Shoppette. Slug tests are single-well hydraulic tests used to estimate the hydraulic conductivity of an aquifer in the immediate vicinity of the tested well. Slug testing can be performed using either a rising head or a falling head test. Both rising head and falling head tests were used at this site. Detailed slug testing procedures are presented in the *Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater* (Wiedemeier *et al.*, 1995), hereafter referred to as the Technical Protocol document.

Data obtained during slug testing were analyzed using the computer program AQTESOLV® (Geraghty and Miller, Inc., 1994) and the methods of Bouwer and Rice (1976) and Bouwer (1989) for unconfined conditions. The results of slug testing are presented in Section 3.3.2.2 and Appendix A.

2.10 SURVEYING

After completion of field work, the locations and elevations of all new monitoring points and pre-existing monitoring wells were surveyed by White Land Surveying, a licensed land surveyor from Blytheville, Arkansas. The horizontal locations and elevations of the measurement datum (top of PVC well casing), the ground surface adjacent to the well casing, and other site features (e.g., roads, surface water elevations in adjacent drainage canals, and buildings) were measured relative to existing control points referenced to horizontal datum NAD27 and vertical datum NAVD88. Horizontal

locations were surveyed to the nearest 0.1 foot. Measurement datum and ground surface elevations were surveyed to the nearest 0.01 foot. Survey data are presented in Table 2.2 and Appendix A.

SECTION 3

PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section incorporates data collected by Parson ES in March 1996 and data documented in previous reports on Eaker AFB. Investigative techniques used to determine the physical characteristics of the site are discussed in Section 2.

3.1 TOPOGRAPHY AND SURFACE WATER HYDROLOGY

Eaker AFB is located within the Mississippi Embayment of the Atlantic and Gulf Plains physiographic province (Eaker AFB, 1992) and the eastern lowland portion of the Central Mississippi River Valley. The topography in the region is generally level except in areas adjacent to the Mississippi River. Ground surface elevations on the Base range from 245 feet above mean sea level (msl) at the southeastern end of the Base (in the vicinity of Pemiscot Bayou) to 265 feet msl at the northwestern end of the Base. At the BX Shoppette, the topography is flat, and the ground surface elevation is approximately 250 feet msl.

Eaker AFB is located within the St. Francis River watershed of the Lower Mississippi River Basin. Surface water drainage is characteristic of the Mississippi River floodplain, and drainage ditches and bayous have been dredged in the flat terrain to accommodate surface water runoff. The majority of the Base lies above the elevation of the 100-year floodplain, and the potential for flooding is minimal. A combination of open drainage ditches and storm drains is used to capture and direct runoff from the Base (Eaker AFB, 1992). Stormwater runoff in the eastern portion of the Base drains to Pemiscot Bayou, while surface water flow on the western half of the Base drains to Ditch 25. Both of these drainage channels flow southwest to the Little River, which discharges into the St. Francis River. The St. Francis River discharges into the Mississippi River approximately 150 miles south of Eaker AFB. Surface water runoff at the BX Shoppette is collected in a stormwater collection system than channels the water northward to Ditch Number 25, (located approximately 4,000 feet north of the site), and eventually into the Little River to the southwest of the base.

3.2 CLIMATE

The Eaker AFB climate is subtropical, with mild winters and hot, humid summers. July is the warmest month with an average maximum daily temperature of 90 degrees Fahrenheit (°F). The coolest month is January with an average minimum daily temperature of 28°F. The average annual precipitation is 48.3 inches, which is evenly distributed throughout the year. The average annual relative humidity is 69 percent. Flooding occurs during periods of prolonged heavy rainfall, and during the summer months climatic conditions make tornado formation possible (Eaker AFB, 1992).

3.3 REGIONAL GEOLOGY AND HYDROGEOLOGY

The shallow subsurface geology of northeastern Arkansas consists of Quaternary alluvium, which is thickest near the Mississippi River and thins in a westerly direction. The alluvium is composed of interbedded clays, silts, sand, and minor gravel and has an average thickness of 125 feet (Eaker AFB, 1992). The shallow, unconsolidated, Quaternary sediments on Eaker AFB are interpreted to be flood plain and channel deposits associated with the past and present positions of the Mississippi River (Halliburton NUS, 1992). The overlying soils are weathering products of the alluvial deposits and are generally nontransmissive, fine-grained, clayey soils. These soils impede infiltration and allow for rapid runoff of surface water.

Beneath the Quaternary alluvium, sediments in the vicinity of the Base consist of over 2,000 feet of Tertiary and Cretaceous unconsolidated deposits overlying Lower Paleozoic carbonate bedrock (Eaker AFB, 1992). The Tertiary Wilcox Formation is present approximately 900 feet below the Base. The lower part of this formation is composed of sands that produce potable water used by Eaker AFB, the city of Blytheville, and the city of Gosnell (Eaker AFB, 1992). The aquifer is under confined conditions, and the water quality is excellent. Water treatment is required only to remove slightly elevated iron concentrations. The lower Wilcox Formation aquifer is protected from contamination by approximately 800 feet of interbedded unconsolidated sands and clays that form the Claiborne Group.

Shallow groundwater in the vicinity of the Base is present between 7 and 12 feet bgs in the Quaternary alluvium. The sands and gravels comprise the major water-bearing units in the Quaternary deposits. Water from the alluvial aquifer is characterized as moderately hard to very hard (hardness as calcium bicarbonate). Irrigation wells and

rural residences generally obtain water from these Quaternary sands (Eaker AFB, 1992). The upper part of the Quaternary deposits consists of sandy clay and clay, while the remainder of the deposits are sand and gravel. The water table is highest in the area northeast of the Base, indicating an area of surface recharge to the Quaternary sands and gravels (Eaker AFB, 1992). Flood control for the Mississippi River and local flooding are responsible for some groundwater elevation fluctuation. Groundwater in the vicinity of Eaker AFB flows southwest to south.

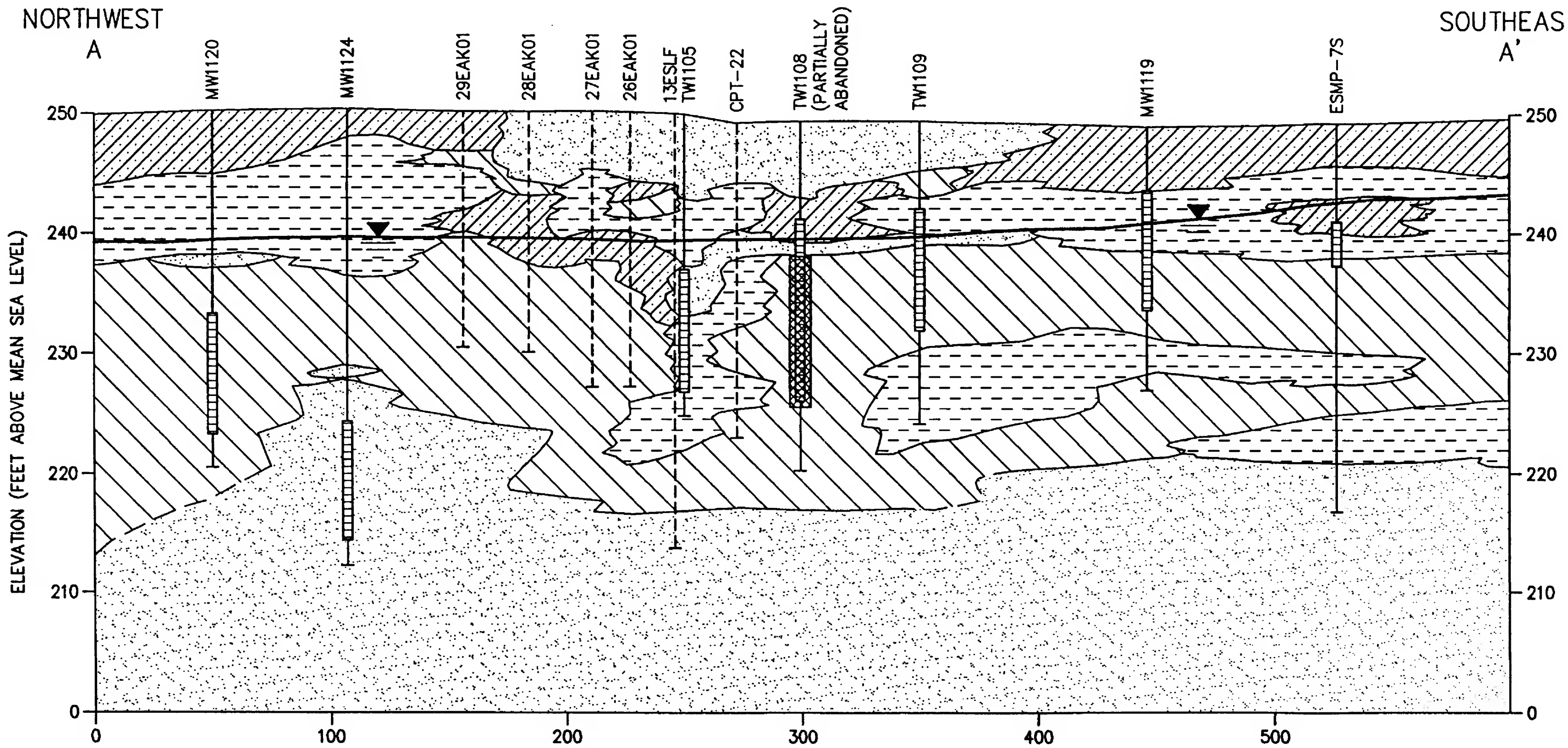
3.4 SITE GEOLOGY AND HYDROGEOLOGY

3.4.1 Lithology and Stratigraphic Relationships

In order to illustrate stratigraphic relationships in the BX Shoppette vicinity, hydrogeologic cross-sections have been developed from subsurface data derived from previous borehole logs and from March 1995 and 1996 CPT/LIF investigation data. Figures 3.1 and 3.2 present hydrogeologic sections A-A' and B-B' that run northwest/southeast, and Figure 3.3 presents hydrogeologic section C-C' which runs northeast/southwest.

Surface soils in the vicinity of the BX Shoppette can be characterized by three distinct zones: a shallow zone of heterogeneous sands, silty sand, silty clay, and clay; a clay zone separating the shallow heterogeneous soils from the aquifer below; and a sandy zone representing the lower sandy aquifer. The soils comprising the shallow aquifer are very heterogeneous, and the likelihood that continuous sandy or silty sand layers acting as preferential flow paths is minimal. Sandy zones in the shallow aquifer appear to be discontinuous lenses. The largest sand lens observed at the site was 4-feet-thick at monitoring well TW-1105 (Figure 3.1). This sand lens thins to the southeast and is not believed to extend more than 150 feet from monitoring well TW-1105.

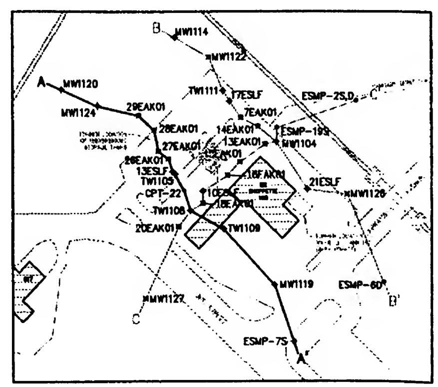
At an average depth of 12 feet bgs at the site, the upper surface of a thick clay layer is encountered. The thickness of this clay layer was observed to vary between 3 and 25 feet on the basis of the hydrogeologic cross sections, and separates the shallow aquifer from the semi-confined aquifer below. The silt content of the clay seems to increase at depth before contact with the sandy aquifer (Halliburton NUS, 1996). Site stratigraphy suggests that vertical pathways may exist from the surface aquifer to the deeper sand aquifer through the thinner sections of the clay layer. The thickness of the fine- to



LEGEND

MW1120	MONITORING WELL/POINT OR CPT/LIF LOCATION IDENTIFICATION
	WELL POINT/SCREEN (DASHED LINE = APPROX LOCATION) (DARKENED WHERE ABANDONED)
	BOTTOM OF BOREHOLE
	GEOLOGIC CONTACT
	APPROXIMATE CONTACT

	SAND, fine to medium grained, brown to gray in color
	SILTY SAND, medium to coarse grained, some clay, dark brown to gray in color
	SILTY CLAY, mottled, some sand, brown to gray in color
	CLAY, gray, dense, plastic, some silt
	APPROXIMATE LOCATION OF SHALLOW WATER TABLE (MARCH 1996) (DASHED WHERE INFERRED)



HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" =10'

FIGURE 3.1

HYDROGEOLOGIC CROSS-SECTION A-A'

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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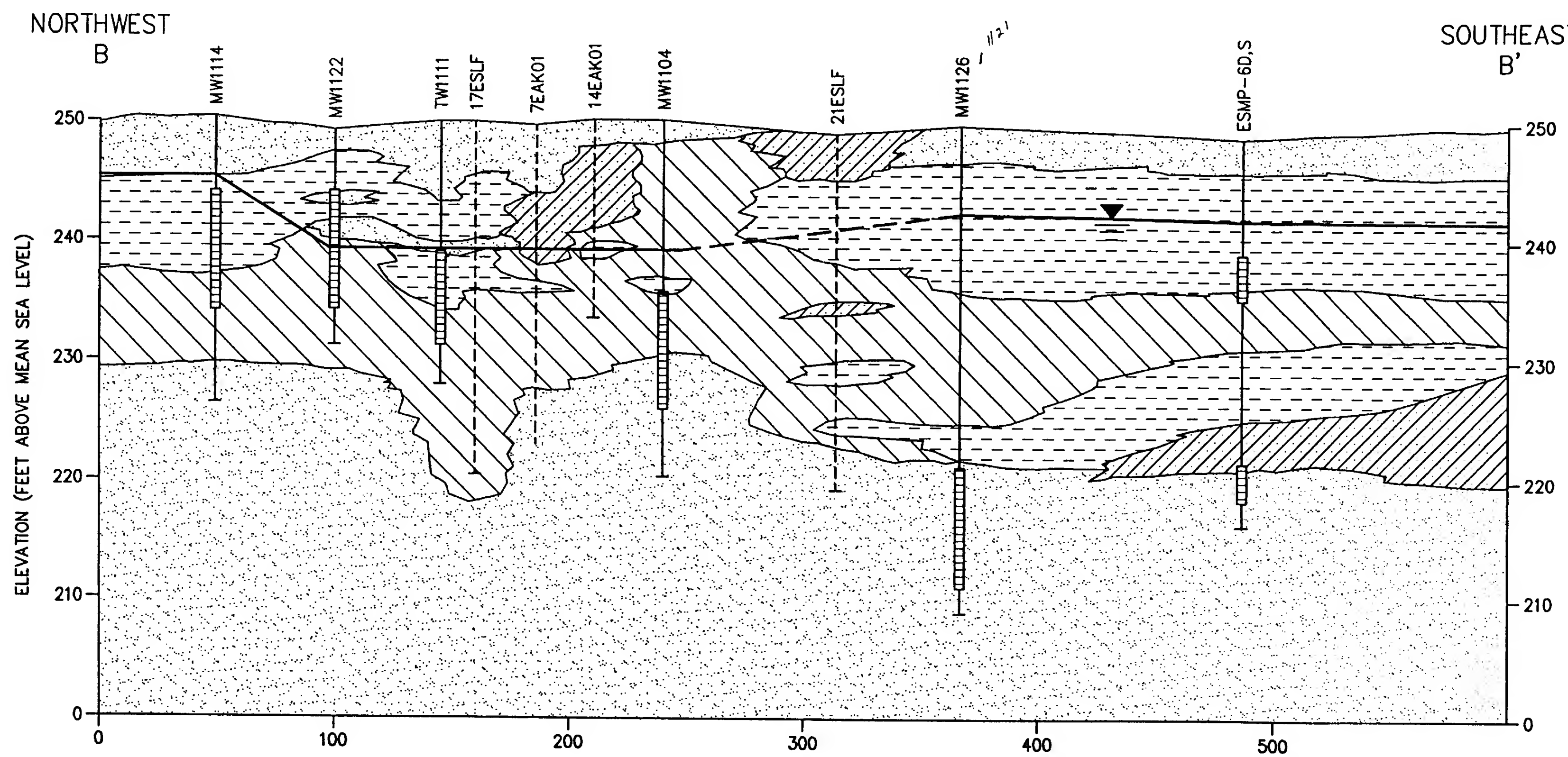

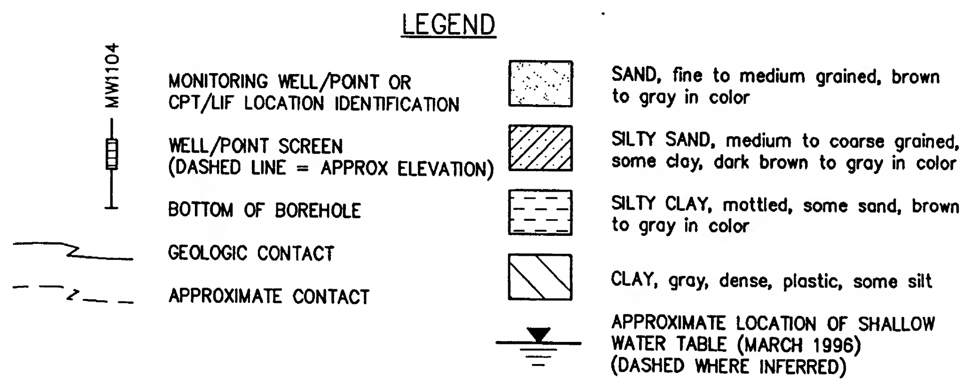

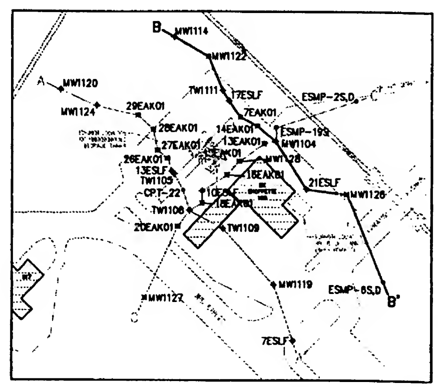

HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" =10'

FIGURE 3.2

HYDROGEOLOGIC CROSS-SECTION B-B'

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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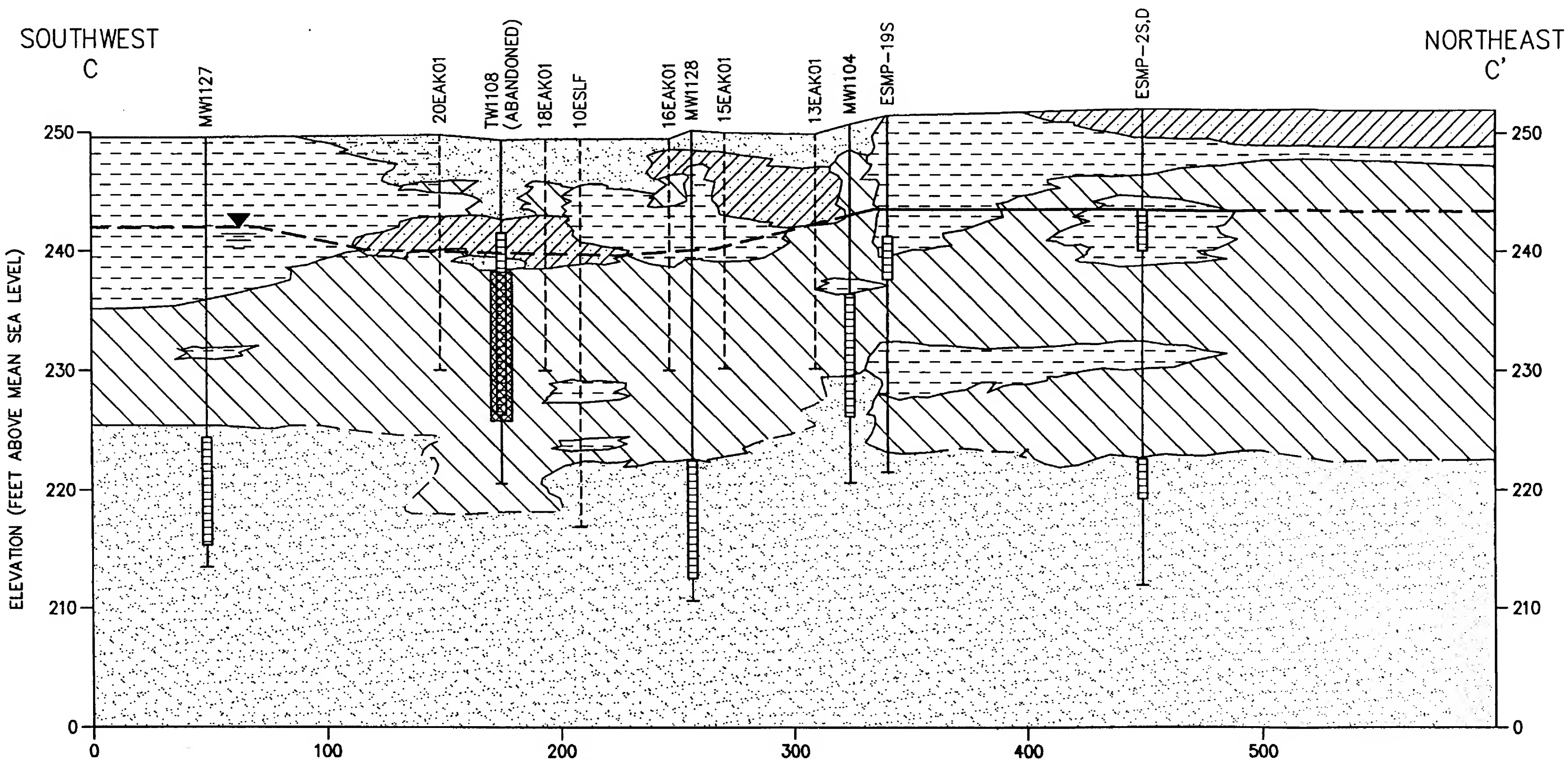
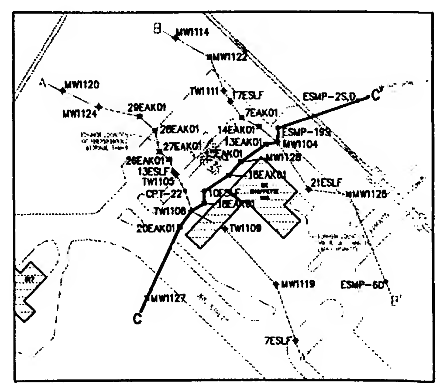


LEGEND

- MW1127 — MONITORING WELL/POINT OR CPT/LIF LOCATION IDENTIFICATION
- WELL POINT/SCREEN (DASHED LINE = APPROX ELEVATION) (DARKENED WHERE ABANDONED)
- BOTTOM OF BOREHOLE
- GEOLOGIC CONTACT
- APPROXIMATE CONTACT
- SAND, fine to medium grained, brown to gray in color
- SILTY SAND, medium to coarse grained, some clay, dark brown to gray in color
- SILTY CLAY, mottled, some sand, brown to grey in color
- CLAY, gray, dense, plastic, some silt
- APPROXIMATE LOCATION OF SHALLOW WATER TABLE (MARCH 1996) (DASHED WHERE INFERRED)



HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" =10'

FIGURE 3.3

HYDROGEOLOGIC CROSS-SECTION C-C'

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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medium-grained sandy aquifer below the clay layer is unknown (no soil boreholes heave reached bedrock), but its thickness is suspected to be greater than 16 feet on the basis of soil data collected at soil borehole MW-1124.

Figures 3.1 through 3.3 suggest that areas of perched groundwater may exist where clay extends above the groundwater table of the shallow aquifer. Perched conditions may be the cause of unusually high groundwater elevations at monitoring well MW-1114 (screened in silty clay and clay) and ESMP-2S (screened in silty clay). Groundwater elevation are described in more detail in Section 3.4.2.

3.4.2 Groundwater Hydraulics

3.4.2.1 Flow Direction and Gradient

Shallow groundwater elevations measured in March 1992 suggest that groundwater flow at the site converges near the BX service station (Halliburton NUS, 1992). West of the BX Shoppette the groundwater flow was to the northeast; however, the forking of the two drainage channels northwest of the station appeared to create a recharge zone, resulting in a southerly groundwater flow from the confluence toward the site. As a result, groundwater flow directly beneath the BX Shoppette appeared to be deflected to the east by the convergent flows. Hydraulic gradients across the site ranged from 0.016 foot per foot (ft/ft) south of the fuel tank pit to 0.0017 ft/ft in the immediate tank pit and dispenser area (Halliburton NUS, 1992). Figure 3.4 depicts groundwater elevations of the shallow aquifer in March 1992.

Groundwater elevations of the shallow aquifer in March 1996 were different than those measured in March 1992. The March 1996 groundwater migration directions converge from three different flow directions (Figure 3.5). North of the BX Shoppette, the shallow groundwater flow was to the southwest; east of the BX Shoppette the groundwater flow was to the west; and south/southwest of the BX Shoppette the groundwater flow was to the north. As a result, groundwater flow beneath the Shoppette appeared to be channeled to the west/northwest, which is different than the east/southeast channeling that was observed in March 1992. Variations in groundwater flow direction likely result from seasonal precipitation, flood control along the Mississippi valley, and inhibited recharge as a result of surface paving. Differences in groundwater elevation of as much as 4 feet have been documented previously through multiple groundwater

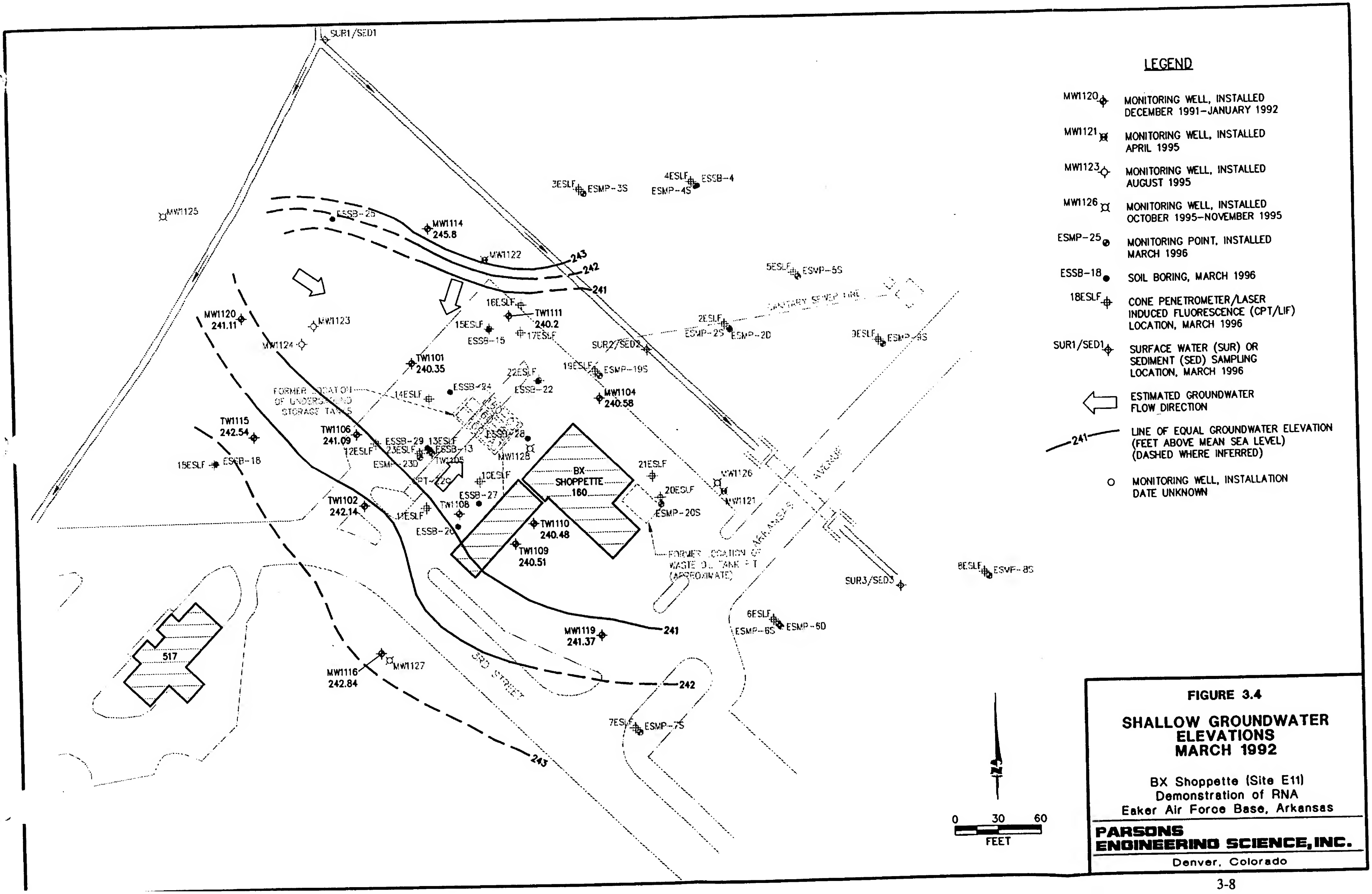

FIGURE 3.4

SHALLOW GROUNDWATER ELEVATIONS MARCH 1992

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

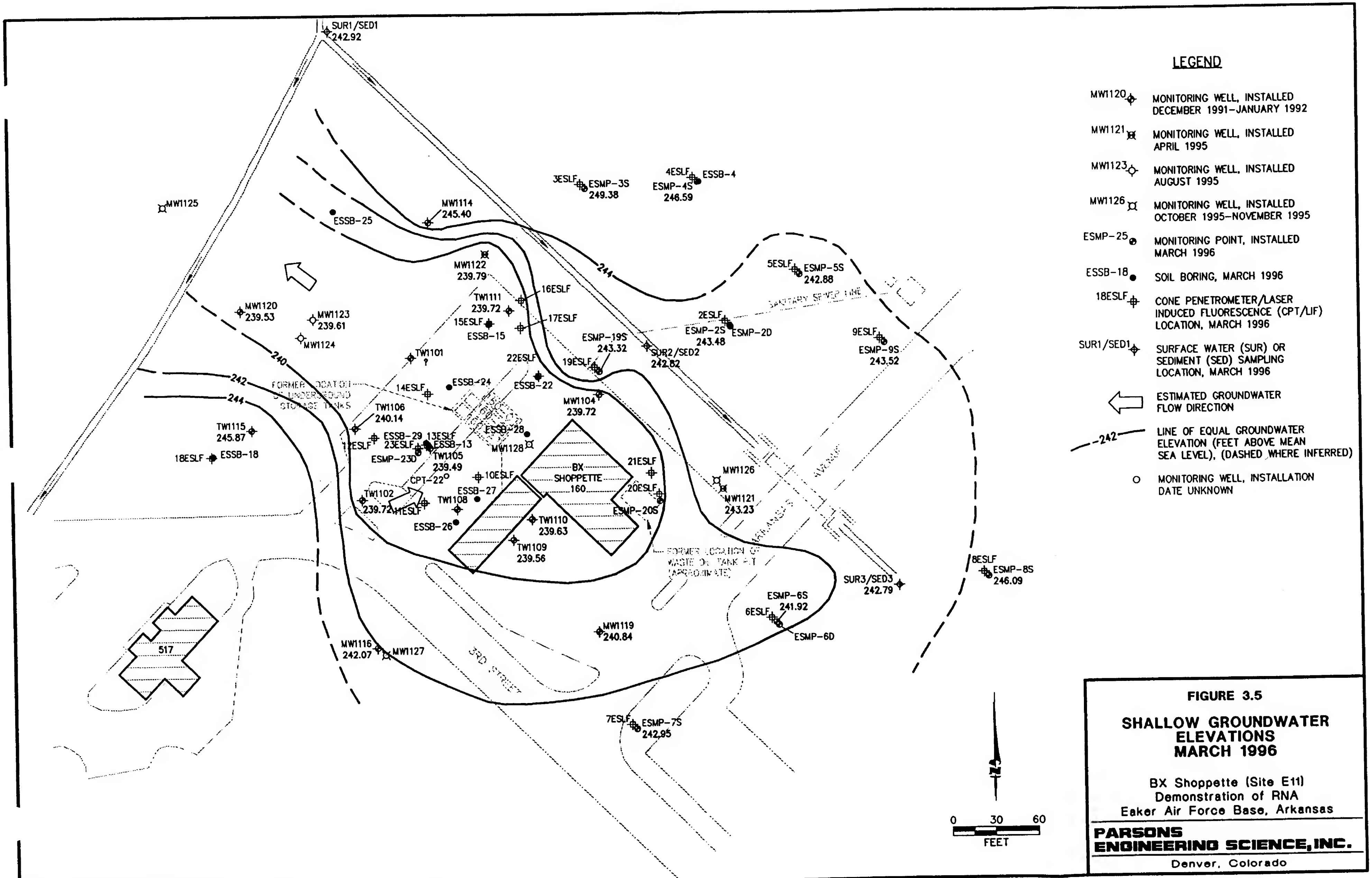

FIGURE 3.5

SHALLOW GROUNDWATER ELEVATIONS MARCH 1996

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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sampling events (Halliburton NUS, 1996). A consistent trend in groundwater elevation is an apparent depression in the groundwater table in the vicinity of the former USTs. This depression is most likely caused by inhibited surface recharge and site geology, and potentially limits groundwater migration away from the site. Groundwater elevations from March 1996 are summarized in Table 3.1.

The overall groundwater flow direction in March 1996 was to the east/southeast (despite localized changes in flow direction), as indicated by groundwater BTEX migration to the east/southeast of the source area (Section 4). Similar detections of BTEX at low concentration were not observed in monitoring wells located between the source area and the northeast/southwest flowing canal. Both drainage canals bounding the site to the northeast and northwest were continuously flowing, as indicated by flow arrows in Figure 3.5. Surface water depth in the canals was approximately 9 inches. The average elevation of the bottoms of the drainage canals is 242 feet msl, which is above groundwater elevations in the source area.

Horizontal gradients at the site in March 1996 ranged from 0.00061 ft/ft to 0.0088 ft/ft in the vicinity of the former USTs to a range of approximately 0.021 to 0.067 ft/ft in the areas of convergent groundwater flow surrounding the Shoppette to the south, east, and north. Relatively high groundwater elevations to the north of the Shoppette (e.g., ESMP-3S and ESMP-5S), east of the Shoppette (e.g., ESMP-8S), and west of the Shoppette (e.g., TW-1115) suggest that groundwater may be perched atop clay plateaus within the shallow aquifer. Perched conditions and alternating groundwater flow may limit groundwater migration away from the source area. Three nested monitoring well locations and two nested monitoring point locations screened in the shallow and deep aquifers yielded vertical gradients at nested well/point locations ranging from 0.027 to 0.184 ft/ft downward.

Figure 3.6 illustrates the deeper groundwater table from the semi-confined sand formation below the clay layer. Groundwater elevations from the five deep monitoring wells/points located at the site have little variability and range from 239.44 to 239.66 feet msl. The approximate groundwater flow direction of the sandy aquifer is to the southwest with a gradient of 0.00026 ft/ft.

TABLE 3.1
GROUNDWATER ELEVATION DATA
BX SHOPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Well Location	Date	Well ID (inches)	Datum Elevation (ft msl)[a/]	Ground Elevation (ft msl)	Depth to Free Product (ft btoc)[b/]	Total Depth to Water (ft btoc)	Corrected Depth to Water[e/] (ft btoc)	Elevation of Water Table (ft msl)
ESMP-2S	3/30/96	0.5	251.62	251.47	ND[c/]	8.14	8.14	243.48
ESMP-2D	3/30/96	0.5	251.65	251.47	ND	11.99	11.99	239.66
ESMP-3S	3/30/96	0.5	251.36	251.56	ND	3.98	3.98	247.38
ESMP-4S	3/30/96	0.5	252.04	252.08	ND	5.45	5.45	246.59
ESMP-5S	3/30/96	0.5	251.22	251.25	ND	8.34	8.34	242.88
ESMP-6S	3/30/96	0.5	249.41	249.55	ND	7.49	7.49	241.92
ESMP-6D	3/30/96	0.5	249.35	249.55	ND	9.84	9.84	239.51
ESMP-7S	3/30/96	0.5	249.27	249.26	ND	6.32	6.32	242.95
ESMP-8S	3/30/96	0.5	251.41	251.48	ND	5.32	5.32	246.09
ESMP-9S	3/30/96	0.5	248.83	248.94	ND	5.31	5.31	243.52
ESMP-19S	3/30/96	0.5	251.21	251.19	ND	7.89	7.89	243.32
ESMP-20S	3/30/96	0.5	NA[d/]	248.97	ND	7.77	7.77	NA
CPT-22	3/30/96	2	249.12	249.34	ND	13.38	13.38	235.74
TW-1102	3/30/96	2	248.47	248.67	ND	8.75	8.75	239.72
MW-1104	3/30/96	2	250.45	250.63	ND	10.73	10.73	239.72
TW-1105	3/30/96	2	250.12	250.31	9.52	14.26	10.63	239.49
TW-1106	3/30/96	2	249.92	250.12	ND	9.78	9.78	240.14
TW-1109	3/30/96	2	249.84	250.03	ND	10.28	10.28	239.56
TW-1110	3/30/96	2	250.21	250.35	ND	10.58	10.58	239.63
TW-1111	3/30/96	2	250.31	250.43	ND	10.59	10.59	239.72
MW-1114	3/30/96	2	250.62	250.80	ND	5.22	5.22	245.40
TW-1115	3/30/96	2	249.35	249.53	ND	3.48	3.48	245.87
MW-1116	3/30/96	2	249.55	249.89	ND	7.48	7.48	242.07
MW-1119	3/30/96	2	248.64	248.86	ND	7.80	7.80	240.84
MW-1120	3/30/96	2	250.70	250.85	ND	11.17	11.17	239.53
MW-1121	3/30/96	2	252.24	249.86	ND	9.01	9.01	243.23
MW-1122	3/30/96	2	252.19	249.70	ND	12.40	12.40	239.79
MW-1123	3/30/96	2	252.72	250.33	ND	13.11	13.11	239.61
MW-1124	3/30/96	2	253.13	250.53	ND	13.32	13.32	239.81
MW-1125	3/30/96	2	252.64	249.57	ND	13.34	13.34	239.30
MW-1126	3/30/96	2	252.80	250.01	ND	13.31	13.31	239.49
MW-1127	3/30/96	2	249.72	249.90	ND	10.28	10.28	239.44
MW-1128	3/30/96	2	250.11	250.35	ND	10.62	10.62	239.49

[a/] ft msl = Feet above mean sea level.

[b/] ft btoc = Feet below top of casing.

[c/] ND = Not decteced.

[d/] NA = Not available.

[e/] Calculated as: [(total depth to water - ((total depth to water) - (total depth to product))* 0.765], where 0.765 is the assumed specific gravity of JP-4 fuel.

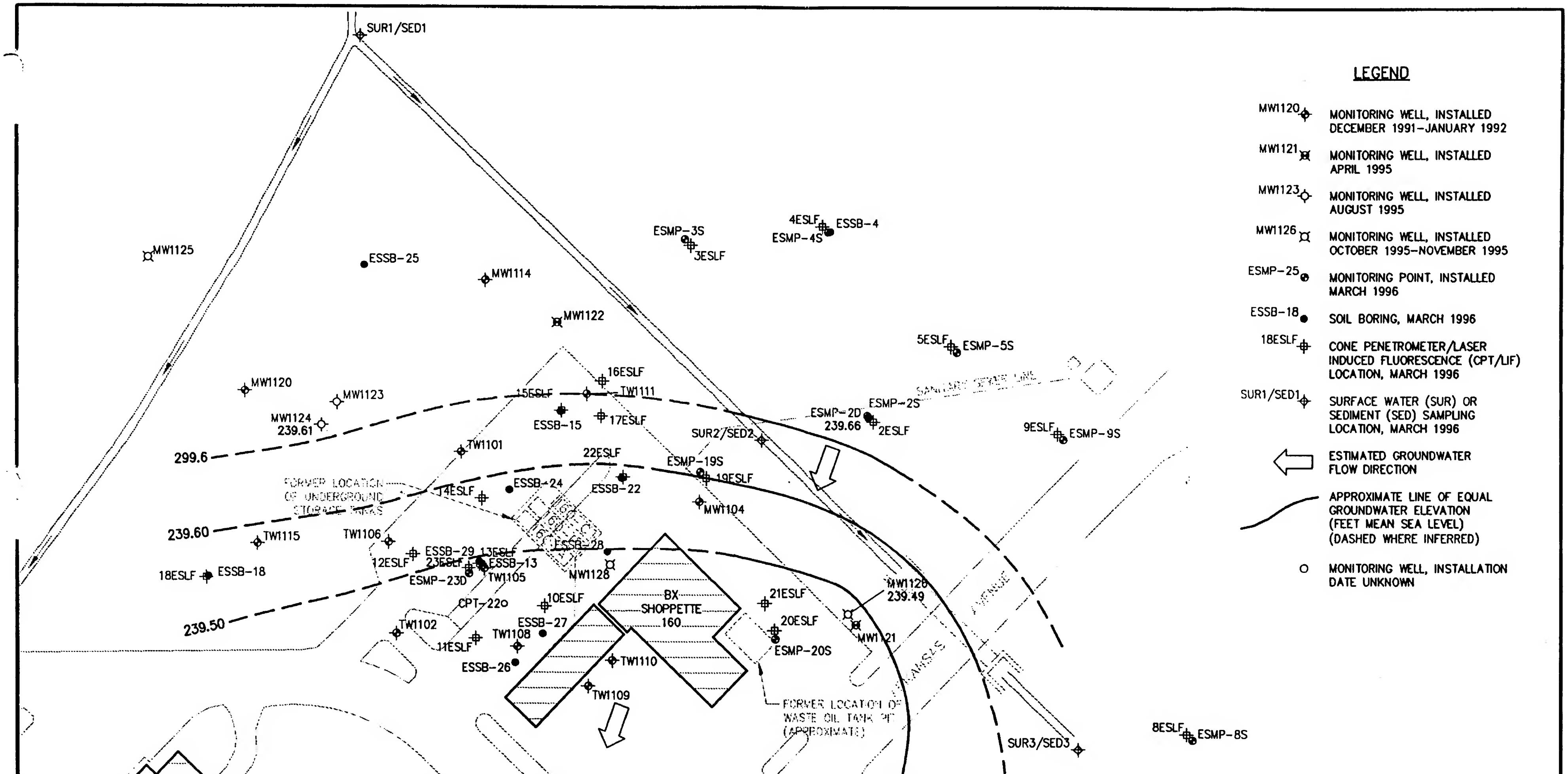

FIGURE 3.6

POTENTIOMETRIC SURFACE OF THE SEMI-CONFINED SAND AQUIFER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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3.4.2.2 Hydraulic Conductivity

Parsons ES estimated the hydraulic conductivity at five shallow monitoring wells (MW-1104, MW-1116, MW-1119, MW-1121, and MW-1123) and four deep monitoring wells (MW-1124, MW-1125, MW-1126, and MW-1127) using rising and falling head slug tests and the analysis method of Bouwer and Rice (1976), as described in Section 2.8. The results of these slug tests are summarized in Table 3.2. The average hydraulic conductivity for the shallow aquifer is 3.78 feet per day (ft/day). The average hydraulic conductivity for the deep aquifer is 3.77 ft/day.

2 ft/day.
$K = 7.1 \times 10^{-4}$ cm/s
2 ft/day
↓
V = 49.5 ft/y
DH
BY 25×100DL×L
⇓
1st order plume
- Ext. 150'
- Int. 150'
- No Deg. 200'

3.3.2.3 Effective Porosity

Because of the difficulty involved in accurately determining effective porosity, especially is heterogeneous soils, accepted literature values for the type of soil comprising the shallow and deep aquifers were used. Walton (1988) gives ranges of effective porosity for fine to medium sand of 0.1 to 0.3, for silt of 0.01 to 0.3, and for sandy clay of 0.03 to 0.2. Because the presence of silty and sandy soils offer the preferred migration pathway, and silts and sands tend to increase the effective porosity, especially in the saturated zone, an effective porosity of 0.25 was assumed both for soils in the shallow aquifer and for the sands of the lower semi-confined aquifer.

3.3.2.4 Advective Groundwater Velocity

The advective velocity of groundwater in the direction parallel to groundwater flow is given by:

$$\bar{v} = \frac{K}{n_e}\frac{dH}{dL}$$

Where: $\bar{v}$ = Average advective groundwater velocity (seepage velocity)
K = Hydraulic conductivity (3.78 ft/day shallow; 3.77 ft/day deep)
dH/dL = Gradient (0.0088 ft/ft shallow; 0.00026 ft/ft deep)
n_e = Effective porosity (0.25 shallow and deep).

Using this relationship in conjunction with site-specific data, the maximum estimated advective groundwater velocities at the site in March 1996 was 0.21 ft/day [77.4 feet per year (ft/yr)] for the shallow aquifer and 0.003 ft/day (1.2 ft/year) for the deep aquifer.

0.003 = 1.095 ≈ 1.0 ft/dy

TABLE 3.2
MARCH 1996 SLUG TEST RESULTS
BX SHOPPETTE
DEMONSTRATION OF RNA
EAKER AFB, ARKANSAS

WELL (Type of Test)	HYDRAULIC CONDUCTIVITY (ft/min)	HYDRAULIC CONDUCTIVITY (ft/day)
SHALLOW WELLS		
MW1104 (rising)	0.000030	0.04
MW1116 (rising)	0.004089	5.89
MW1116 (falling)	0.009678	13.94
MW1119 (rising)	0.000432	0.62
MW1119 (falling)	0.001850	2.66
MW1121 (avg. rising)	0.000597	0.86
MW1121 (avg. falling)	0.002842	4.09
MW1123 (avg. rising)	0.001469	2.12
AVERAGE	0.002623	3.78
DEEP WELLS		
MW1124 (avg. falling)	0.002194	3.16
MW1125 (avg. rising)	0.001983	2.86
MW1125 (avg. falling)	0.003957	5.70
MW1126 (avg. rising)	0.002389	3.44
MW1126 (avg. falling)	0.003385	4.87
MW1127 (avg. rising)	0.002210	3.18
MW1127 (avg. falling)	0.002185	3.15
AVERAGE	0.002615	3.77

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Because organic carbon is generally present in any aquifer matrix, a somewhat retarded velocity should be used for solute transport calculations. Section 4.3.2. presents TOC analysis results, and Section 5 discusses contaminant retardation in more detail.

3.4.2.5 Potential Exposure Pathways

No preferential groundwater flow paths to downgradient receptors appear to exist at the site on the basis of groundwater elevations and hydraulic and lithologic data. Highly conductive sand and silty sand lenses appear to be discontinuous and offer no direct route to potential downgradient receptors. Possible discharge of groundwater contamination from the surface aquifer to either drainage canal may be possible depending on flow conditions; however, groundwater elevations in March 1996 in the source area were below the elevation of the drainage canal beds.

Migration of mobile LNAPL appears to be limited to conductive sand and silt zones or lenses that become available as water levels vary. The heterogeneity of soils and presence of impermeable silty clay or clay layers has prevented any significant migration of LNAPL from the source area. Potential contamination of the semi-confined aquifer from the surface aquifer through breaks in the separating clay layer has occurred, as indicated by BTEX contamination in the sandy aquifer at MW-1124 (Section 4). It is unlikely that mobile LNAPL has contaminated the lower aquifer because this semi-confined aquifer is pressurized and the potentiometric surface of the semi-confined aquifer is above the bottom of the thick clay layer. Therefore, floating LNAPL would have no mechanism for downward transport. However, it is likely that fluctuating groundwater elevations permit hydraulic conditions that allow dissolved BTEX contamination to reach the deep aquifer.

3.4.3 Groundwater Use

The potential for exposure to contaminated water originating from the site through drinking water supplies is low because potable water supplies are not obtained from the surface or deeper sand aquifers. Eaker AFB previously (prior to Base closure) obtained its water from two wells located on the southeast side of Louisiana Avenue between Second and Third streets, approximately 4,200 feet southwest of the site. The wells were drilled to approximately 1,310 feet bgs and drew water from the Wilcox Formation. The city of Blytheville (south of the base) obtains its water from four deep wells located

approximately 2.3 miles southeast of the Base. The city of Gosnell (west of the Base) obtains its water from two deep wells drilled to 1,100 feet bgs. Therefore, the migration of contamination in Quaternary sands to domestic wells beyond the perimeter of the Base or into the Wilcox formation is extremely unlikely.

SECTION 4

NATURE AND EXTENT OF CONTAMINATION AND SOIL AND GROUNDWATER GEOCHEMISTRY

4.1 SOURCE OF CONTAMINATION

The source of contamination at the BX Shoppette appears to be centered around the former location of gasoline USTs and associated piping northwest/west of the Shoppette. The first reported leak occurred in 1974 from a transfer pipe connecting the USTs to the fuel dispensers. The leak was repaired, and no hydrocarbon-contaminated soils were removed during the repair (Halliburton NUS, 1992). The next recorded leak occurred in 1989 when UST No. 160A tested positive for leaks and was deactivated in March 1990. Tank tightness tests were performed on the remaining USTs in August 1990. The USTs were determined to be leak-free; however, the associated piping to each of the tanks was determined to be leaking (Halliburton NUS, 1992). An unknown volume of fuel has been released from UST or transfer piping leaks over the history of the site. In addition to gasoline, waste oil, waste hydraulic fluid, and contaminated fuels were generated at the site (Halliburton NUS, 1996).

Other than the recovery of approximately 10.75 gallons of LNAPL in February 1992 and the excavation of 600 cubic yards (cy) of contaminated soils during the UST removal, no other source reduction occurred prior to the March 1996 site characterization effort. In September 1996, a bioslurping system was installed at monitoring wells TW-1105 and TW-1108 to begin removing mobile LNAPL from the source area. Approximately 250 gallons of LNAPL had been removed by October 1996. Section 4.2 describes mobile LNAPL levels at the site with respect to March 1996 site conditions and does not account for the effects of recent bioslurping.

4.2 MOBILE LNAPL CONTAMINATION

Mobile LNAPL is defined as the LNAPL that is free to flow in the aquifer and that will flow from the aquifer matrix into a well under the influence of gravity. Mobile

LNAPL was observed in March 1996 west of the Shoppette and southwest of the former gasoline UST location. Monitoring wells TW-1105 and TW-1108 contained 4.74 and 2.97 feet of LNAPL, respectively. Monitoring well TW-1108 was previously abandoned and filled with concrete to within 11.5 feet of the groundsurface; however, sufficient screen was left exposed in the unsaturated zone to allow the flow of LNAPL into the well. High fluorescence intensities (>13,000 normalized counts) at CPT/LIF push locations 1EAK01, 3EAK01, 19EAK01, 22EAK01, 26EAK01, 13ESLF, and 23ESLF, combined with mobile LNAPL observations in monitoring wells TW-1105 and TW-1108 suggest that mobile LNAPL occupies an area approximately 70 feet long by 15 feet wide between CPT/LIF locations 26EAK01 and 19EAK01 (Figure 4.1). Mobile LNAPL may be migrating and accumulating within a southeast trending sand lens near the water table (Figure 3.1).

Mobile LNAPL has been observed in temporary monitoring well TW-1105 since February 1992 (4.77 ft) (Halliburton NUS, 1996); however, mobile LNAPL was not observed in temporary monitoring well TW-1108 until November 1995 (0.05 ft) (Halliburton NUS, 1996). The increase in LNAPL between November 1995 and March 1996 at temporary well TW-1108 suggests the possible migration of LNAPL to this location. Furthermore, the mobile LNAPL thickness measured in monitoring well TW-1105 in March 1996 (4.74 feet) is less than measured in May of 1995 (7.8 feet). The decreasing thickness at TW-1105 in conjunction with the increasing thickness at TW-1108 suggests that the mobile LNAPL may have flowed more evenly into the sand lens screened by both wells.

An LNAPL sheen was detected in monitoring well TW-1111 in March 1996. The product source is unknown because the well is located north of (upgradient from) the former UST locations. The potential area and volume of LNAPL at this location is expected to be small on the basis of CPT/LIF push locations near monitoring well TW-1111 (6EAK01 through 8EAK01 and 15ESLF through 17ESLF). Fluorescence intensities at these six locations did not indicate the presence of a significant LNAPL source. The source of contamination may have been a previous slug of contamination that migrated north through unsaturated soils from the source area or an unreported surface release.

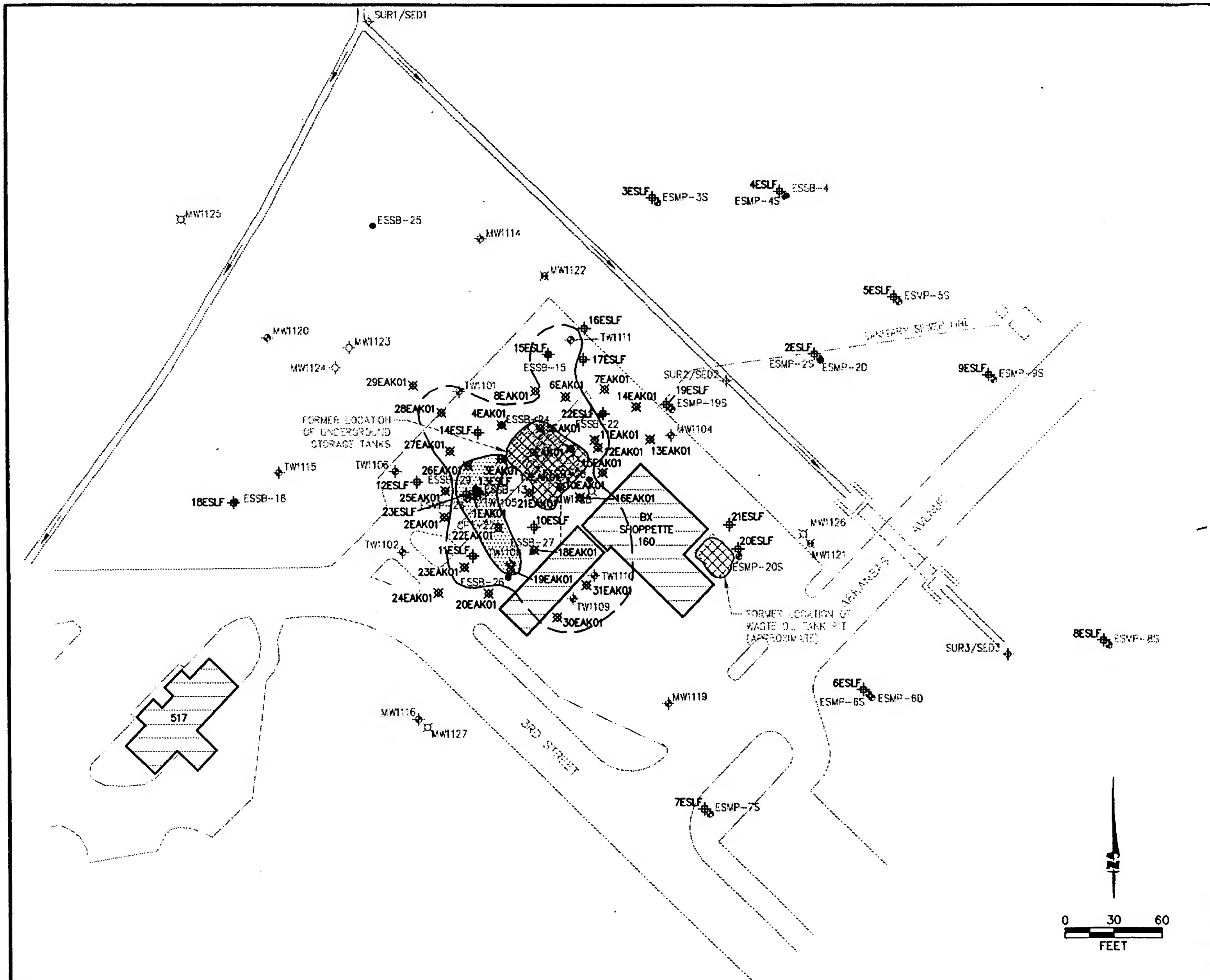

FIGURE 4.1

EXTENT OF SOIL CONTAMINATION BASED ON FLUORESCENCE INTENSITY AND OBSERVED MOBILE LNAPL

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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The relationship between the measured LNAPL thickness in a monitoring well and the total amount of mobile LNAPL in the subsurface at a site is extremely difficult to quantify. It is well documented that LNAPL thickness measurements taken in groundwater monitoring wells are not indicative of actual mobile LNAPL thicknesses in the formation (de Pastrovich *et al.*, 1979; Blake and Hall, 1984; Hall *et al.*, 1984; Hughes *et al.*, 1988; Abdul *et al.*, 1989; Testa and Paczkowski, 1989; Kemblowski and Chiang, 1990; Lehnard and Parker, 1990; Mercer and Cohen, 1990; Ballestero *et al.*, 1994). It has been noted by these authors that the thickness of LNAPL measured in a monitoring well is greater than the actual mobile LNAPL thickness present in the aquifer, and according to Mercer and Cohen (1990), measured LNAPL thickness in wells is typically 2 to 10 times greater than the actual mobile LNAPL thickness in the formation. Assuming an approximate LNAPL thickness of 0.5 foot in the aquifer matrix (a 0.5 foot mobile LNAPL thickness was measured by CPT/LIF at location 23ESLF), an areal extent of approximately 70 feet by 15 feet, and a soil porosity of 0.3 an approximated volume of mobile LNAPL at the site in March 1996 is 1,200 gallons.

BTEX compounds are considered good indicators of fuel weathering because BTEX compounds constitute by far the greatest mass of compounds that partition from fuels into groundwater (Smith *et al.*, 1981; Cline *et al.*, 1991). In 1:10 fuel:water mixtures, BTEX can comprise as much as 82 percent of the total dissolved contaminant concentrations in the water (Smith *et al.*, 1981). Concentrations of BTEX constituents in mobile LNAPL collected from temporary monitoring wells TW-1105 and TW-1108 were quantitated using US Environmental Protection Agency (USEPA) Method SW8020. Concentrations of BTEX from these samples indicated that the petroleum product comprising the gasoline plume is weathered. Table 4.1 compares the BTEX concentrations in fresh unleaded gasoline to those observed in gasoline (presumably unleaded) samples collected from temporary monitoring wells TW-1105 and TW-1108.

Compared to fresh gasoline, the gasoline from both samples is moderately weathered with respect to the BTEX compounds and specifically to benzene and toluene. The gasoline at temporary monitoring well TW-1108 was slightly more weathered (approximately 8 percent less BTEX compounds) than the gasoline collected at temporary monitoring well TW-1105. This suggests that the gasoline originated near TW-1105 and possibly weathered during migration to TW-1108.

TABLE 4.1
MOBILE LNAPL ANALYTICAL RESULTS
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

COMPOUND	CONCENTRATION IN FRESH GASOLINE [a/] (mg/L)[c/]	CONCENTRATION IN PRODUCT FROM TW-1105[b/] (mg/L)	CONCENTRATION IN PRODUCT FROM TW-1108[b/] (mg/L)
Benzene	16,800	7,650	7,610
Toluene	80,400	49,725	43,815
Ethylbenzene	10,875	9,945	9,225
Total Xylenes	45,300	50,490	45,355
Total BTEX	153,375	117,810	106,005

[a/] Data from Bruce *et al.* (1991); average of 5 unleaded gasolines.
[b/] USEPA Method SW8020.
[c/] mg/L = Milligrams per liter.

The liquid densities of gasoline from temporary wells TW-1105 and TW-1108 were 0.7650 and 0.7687 kilograms per liter (kg/L), respectively. The density of unweathered gasoline is 0.7321 kg/L. The elevated gasoline densities from the temporary monitoring wells suggests weathering by the partial loss of volatile hydrocarbons (such as the alkane fractions), thereby leaving heavier and less volatile compounds for an increase in density.

4.3 SOIL QUALITY

4.3.1 Residual Contamination

Residual LNAPL is defined as the LNAPL that is trapped in the aquifer by the processes of cohesion and capillarity, and therefore will not flow within the aquifer and will not flow from the aquifer matrix into a well under the influence of gravity. At this site, the residual LNAPL consists mostly of fuel hydrocarbons derived from automotive gasoline.

4.3.1.1 Soil Analytical Data

Soil sampling data are available for sampling events that took place in 1991 through 1996. In 1991, 56 soil samples were collected by Halliburton NUS (1994) from boreholes B-1 through B-27, and 12 soil samples were collected from boreholes for wells TW-1103, TW-1108, TW-1109, and TW-1110 (Figure 4.2). During the 1991 investigation, saturated and unsaturated zone soil samples were collected at depths ranging from 5 to 22 feet bgs. In 1995, Halliburton NUS collected 11 additional soil samples during the installation of monitoring wells MW-1121 through MW-1123 and soil boreholes SB1129 through SB1135 (Halliburton NUS, 1996). These 11 samples were collected from unsaturated soil at depths ranging from 2.0 to 9.7 feet bgs. All the soil samples collected during these sampling events were analyzed for BTEX and total petroleum hydrocarbons (TPH). Some soil samples were analyzed for additional contaminants (e.g., metals); however, results reported for these additional analytes are not of primary importance for completion of this RNA demonstration and are not summarized. Total BTEX concentrations were measured in all soil samples collected between February and June 1991 (B-1 through B-27) at concentrations ranging from 0.5 to 785 milligrams per kilogram (mg/kg). Total BTEX concentrations in soil were detected only at soil borehole location SB1135 at a maximum concentration of 122.1 mg/kg in April 1995. Appendix B summarizes BTEX and TPH results for all soil samples collected during these sampling efforts.

Thirteen soil samples were collected from 11 soil borehole locations in March 1996 as part of this study. The soil samples were collected by either the CPT or the Geoprobe® across 0.5- to 2-foot intervals in the vadose zone (from 7 to 12.5 feet bgs). BTEX, chlorobenzene, TMB, and TEMB compounds were analyzed at locations ESSB-13 (2 depths), ESSB-15, ESSB-22, ESSB-24, ESSB-26, ESSB-27, ESSB-28, and ESSB-29 (2 depths). TOC samples were collected from locations ESSB-4, ESSB-18, ESSB-25, and ESSB-26, and the results are summarized in Section 4.3.2. Figure 4.2 illustrates locations at which BTEX was detected, and Table 4.2 summarizes the March 1996 soil sampling results.

Figure 4.2 is a map showing the areal extent of detected BTEX contamination in soils in 1991, 1995, and 1996 to a maximum depth of 20 feet bgs. The unsaturated soil BTEX contamination appears to be confined within the site boundaries. The maximum total BTEX contamination measured in unsaturated soils (5,330 mg/kg) was detected in march

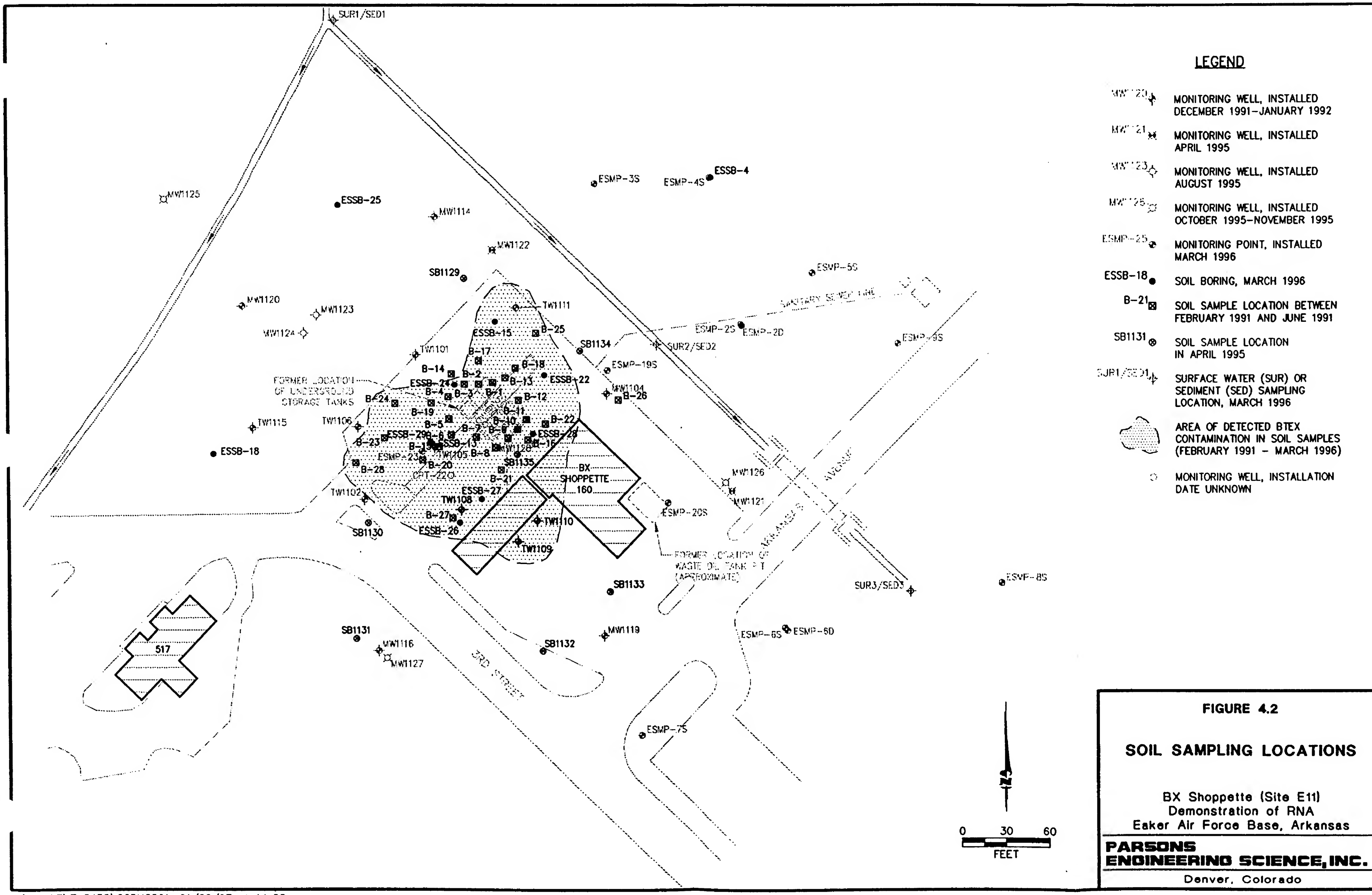

FIGURE 4.2

SOIL SAMPLING LOCATIONS

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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TABLE 4.2
FUEL HYDROCARBON COMPOUNDS DETECTED IN SOIL AND SEDIMENT
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Sample Location	Sample Date	Sample Depth (feet)	TVPH[a/] (mg/kg)[b/]	Benzene (µg/kg)[c/]	Toluene (µg/kg)	Ethylbenzene (µg/kg)	Total Xylenes (µg/kg)	Total BTEX (µg/kg)	Chloro-benzene (µg/kg)	1,3,5-TMB (µg/kg)	1,2,4-TMB (µg/kg)	1,2,3-TMB (µg/kg)	1,2,3,4-TEMB (µg/kg)
SOIL													
ESSB-13	3/28/96	7 - 8.5	3600	6500	160000	38000	170000	374500	ND[d/]	49000	150000	56000	31000
ESSB-13	3/28/96	12 - 12.5	1000	1200	17000	9600	39000	66800	ND	13000	42000	15000	8300
ESSB-15	3/28/96	10 - 10.5	0.30	1.8	3.2	ND	3.4	8.4	ND	ND	2.3	ND	ND
ESSB-22	3/28/96	9.5 - 10	890	12000	46000	11000	57000	126000	ND	9400	26000	6900	8500
ESSB-24	3/28/96	8 - 10	200	990	2800	1700	7000	12490	ND	3100	9600	2300	1900
ESSB-26	3/28/96	8 - 10	47000	130000	1800000	600000	2800000	5330000	24000	570000	1500000	410000	390000
ESSB-27	3/28/96	8.5 - 10	380	2800	14000	5000	26000	47800	ND	3600	15000	5800	2800
ESSB-28	3/28/96	8 - 10	1100	6700	40000	14000	70000	130700	ND	14000	41000	14000	9100
ESSB-29	3/28/96	7 - 8.5	3200	ND	67000	35000	180000	282000	1200	53000	150000	58000	47000
ESSB-29	3/28/96	8.5 - 10.25	7600	13000	250000	98000	470000	831000	3400	100000	300000	100000	69000
SEDIMENT													
ES-SED-1	3/29/96	Sediment	NA[e/]	ND	19	ND	ND	19	ND	ND	ND	ND	ND
ES-SED-2	3/29/96	Sediment	NA	ND	5.9	ND	1.4	7.3	ND	ND	ND	ND	ND
ES-SED-3	3/29/96	Sediment	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

[a/] TVPH = Total volatile petroleum hydrocarbons (quantified against a gasoline standard).
[b/] mg/kg=Milligrams per kilogram.
[c/] µg/kg=Micrograms per kilogram.
[d/] ND = Not Dectected.
[e/] NA = Not analyzed.
Note: TVPH analyzed using USEPA Method SW8015M.
BTEX, Chlorobenzene, and TMB compounds analyzed using USEPA Method SW8020.

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1996 in soil borehole ESSB-26, adjacent to the fueling canopy and abandoned temporary well TW-1108. This sample likely was saturated with mobile LNAPL and is not representative of residual LNAPL contamination. The second highest soil BTEX concentration recorded from all three soil sampling events was 831 mg/kg at soil borehole location ESSB-29. BTEX contamination in the vadose zone is concentrated mostly in the former location of the gasoline USTs, along the fuel transfer lines to the fueling canopy, and in the fueling canopy area. The remainder of the soil sampling indicated lower BTEX concentrations throughout the rest of the BX Shoppette site (Figure 4.2). A potential second contaminant source was located north of the UST pit near temporary well TW-1111. A sheen was detected at this location during field work as part of this demonstration (Section 4.2) and may be the result of an unreported surface release or slug of LNAPL that migrated northward from the UST location. Detectable concentrations of BTEX in unsaturated soils appear to be limited to an area of 32,000 square feet, extending as far as 120 feet from the former gasoline USTs.

The vertical extent of soil BTEX contamination in the shallow aquifer is believed to extend as much as 22 feet bgs on the basis of saturated soil samples collected in 1991 (Halliburton NUS, 1992). The downward smearing of LNAPL contamination through seasonal variations in groundwater elevations and preferential flow through conductive sand or silt layers has caused saturated soil contamination. The presence of BTEX contamination at soil borehole B-22 (Figure 4.2) suggests the previous downward migration of fuel contamination in conductive sand or silt lenses or stringers.

4.3.1.2 CPT/LIF Data

Three CPT/LIF site investigations were performed at the BX Shoppette to help characterize the horizontal and vertical extent of soil contamination. The first CPT/LIF characterization event occurred in March 1995 and consisted of 31 pushes (EAK01 to EAK31) to a maximum depth of 27 feet bgs. A nitrogen laser was used to scan for free and residual hydrocarbons. Figure 4.1 illustrates the locations of the CPT/LIF push locations. The second CPT/LIF characterization event occurred in October 1996 and consisted of 13 push locations with a tunable LIF probe. The focus of the field effort was to demonstrate the applicability of the tunable LIF probe by correlating the probe readings with adjacent soil cores. Four soil boreholes were completed adjacent to the tunable LIF push locations. However, the tunable LIF detects a different wavelength band than the nitrogen probe and cannot be directly correlated with nitrogen LIF results.

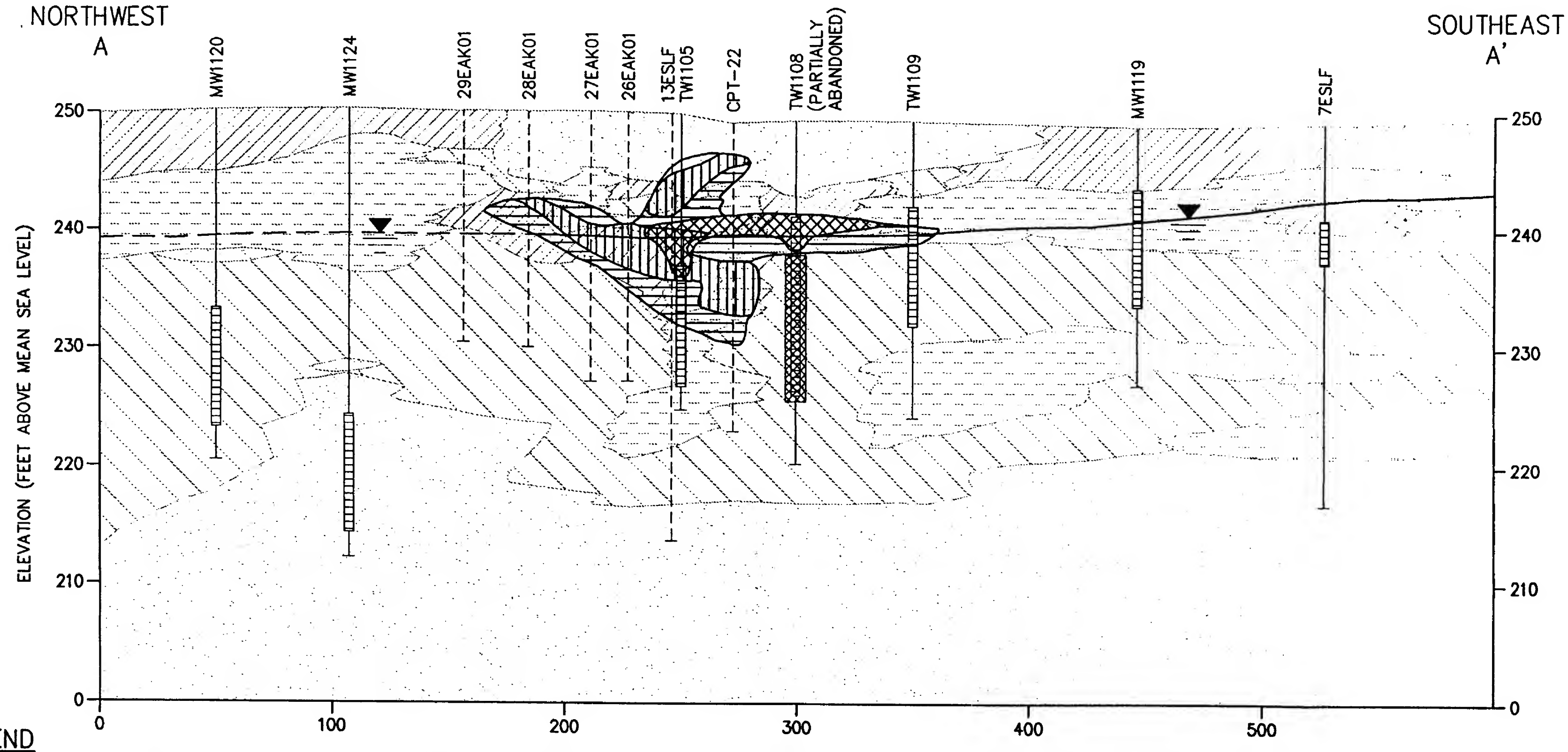
Therefore, the tunable LIF data are not used in this report. The third CPT/LIF site characterization event was conducted in March 1996 during the field work phase of this study and consisted of 23 push locations (1ESLF through 23ESLF) using the nitrogen LIF probe. The maximum push depth during the March 1996 CPT/LIF effort was 48 feet bgs. Monitoring points were installed at 13 of the 23 push locations.

All 54 nitrogen LIF push locations from March 1995 and 1996 were used to delineate residual soil contamination (Figure 4.1). Soil BTEX contamination detected by the nitrogen LIF is comparable in area to the area of BTEX contamination detected with soil analytical data (compare Figure 4.1 with Figure 4.2). The area delineated by the nitrogen LIF probe is smaller than the area delineated through analytical data because the fuel detection limit of the nitrogen LIF is less sensitive than the BTEX detection limit for laboratory analyses. Hydrocarbons were detected as deep as 19 feet bgs at 22EAK01 (former location of temporary monitoring point CPT-22). This suggests that mobile or residual LNAPL has not penetrated the clay layer separating the shallow aquifer from the aquifer below.

The relationship between LNAPL distribution is best illustrated using hydrogeologic profiles. Figures 4.3 and 4.4 present profiles of soil contamination using hydrogeologic cross-section A-A' and C-C'. Figure 4.3 suggests that most soil contamination in this portion of the shallow aquifer is accumulating within the silty sand/sand lens stretching between 28EAK01 and TW-1109. Likewise, Figure 4.4 shows that mobile LNAPL is confined to the sandy lens in the immediate vicinity of TW-1108. The presence of residual LNAPL contamination within 5 feet of the groundsurface suggests that most fuel likely was released through the transfer piping, located north of the canopy, that was used to connect the USTs to the filling apron.

4.3.2 Total Organic Carbon

TOC concentrations are used to estimate the amount of organic matter sorbed to soil particles or trapped in the interstitial passages of a soil matrix. The TOC concentration in the saturated zone is an important parameter used to estimate the amount of contaminant that could potentially be sorbed to the aquifer matrix. Sorption results in retardation of the contaminant plume relative to the average advective groundwater velocity. TOC measurements should be taken in the same soil formation where dissolved groundwater contamination is migrating.



LEGEND

MW1120 — MONITORING WELL/POINT OR CPT/LIF LOCATION IDENTIFICATION

WELL POINT/SCREEN (DASHED LINE = APPROX ELEVATION) (DARKENED WHERE ABANDONED)

BOTTOM OF BOREHOLE

Nitrogen LIF Probe Fluorescence >1000 norm units

Nitrogen LIF Probe Fluorescence >250 norm units Dashed Where Inferred

Mobile Light Non Aqueous-Phase Liquid (LNAPL)

SAND, fine to medium grained, brown to gray in color

SILTY SAND, medium to coarse grained, some clay, dark brown to gray in color

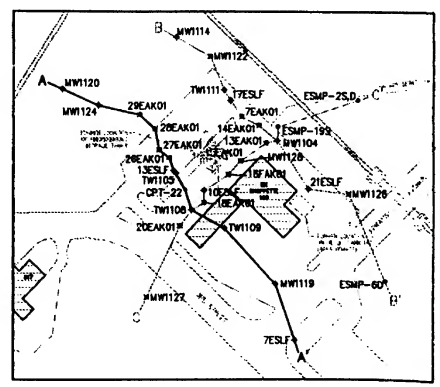
SILTY CLAY, mottled, some sand, brown to gray in color

CLAY, gray, dense, plastic, some silt

APPROXIMATE LOCATION OF WATER TABLE (MARCH 1996) (DASHED WHERE INFERRED)

GEOLOGIC CONTACT

APPROXIMATE CONTACT



HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" =10'

FIGURE 4.3

VERTICAL EXTENT OF SOIL CONTAMINATION (HYDROGEOLOGIC CROSS-SECTION A-A')

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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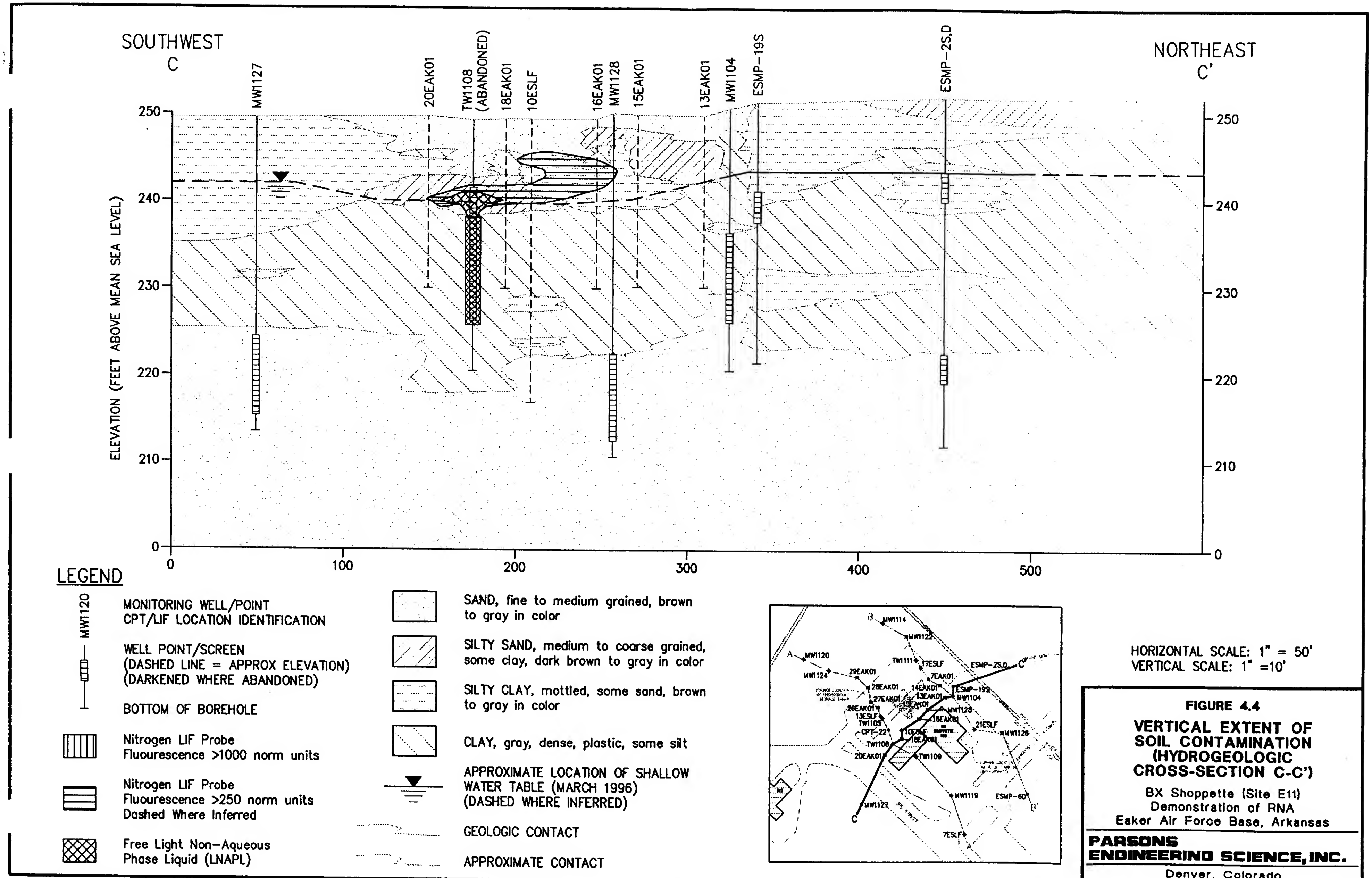

FIGURE 4.4

VERTICAL EXTENT OF SOIL CONTAMINATION (HYDROGEOLOGIC CROSS-SECTION C-C')

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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The percent soil TOC was measured in three samples that were collected in the capillary fringe, peripheral to the mobile and residual LNAPL plume (ESSB-4, ESSB-18, ESSB-25). A fourth TOC sample was collected within the contaminated area at ESSB-26 (adjacent to TW-1108). The collection of TOC samples from the silt/sand formation was difficult due to the heterogeneity of the shallow aquifer soil matrix. As a result, TOC concentrations for samples ESSB-4 and ESSB-18 were excluded from retardation calculations because only clay soils were extracted (TOC contents of 0.16 and 0.15 percent, respectively). The TOC concentrations from ESSB-26 (TOC of 0.05 percent) also was not used because the sample was collected from a contaminated portion of the shallow aquifer. The TOC sample collected from ESSB-25 consisted of a sandy soil that was peripheral to known soil contamination. The TOC of soils from 4 to 6.5 feet bgs was 0.07 percent. This TOC value is indicative of relatively clean soils and was used in retardation calculations.

4.4 SURFACE WATER AND SEDIMENT CHEMISTRY

4.4.1 Surface Water Quality

Surface water samples were collected at three locations (SUR1 through SUR3) in the northwest/southeast running drainage canal located north of the Shoppette (Figure 2.1). The surface water samples were analyzed for VOCs by USEPA Method SW8020. Toluene was detected at low concentration (0.5 μg/L) in sample SUR1, which is located upgradient from the site. No other BTEX , TMB or TEMB compounds were detected in the surface water samples, which suggests that the drainage canal does not receive groundwater contamination from the BX Shoppette. Analytical results for surface water samples are presented in Table 4.3.

4.4.2 Sediment Quality Data

Three sediment samples were collected from the upper 4 inches of the northwest/southeast flowing drainage canal and analyzed for VOCs. The results of sediment sampling are summarized in Table 4.2. The three sampling locations (SED1 through SED3) are the same as those of the surface water samples. Sediment samples SED1 and SED2 contained 19.0 and 7.30 μg/kg of toluene, respectively. In addition, sediment sample SED2 had a low detection of total xylenes (1.4 μg/kg). No other BTEX, TMB, or TEMB compounds were detected in sediment samples at the site. The

TABLE 4.3
FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUNDWATER AND SURFACE WATER
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Sample Location	Sample Date	TVPH-Gasoline[a] (mg/L)[b]	Benzene (µg/L)[c]	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Total BTEX (µg/L)	1,3,5-TMB (µg/L)	1,2,4-TMB (µg/L)	1,2,3-TMB (µg/L)	1,2,3,4,-Tetra (µg/L)
ESMP-2S	3/30/96	1.7	ND[d]	1.1	ND	ND	1.1	ND	ND	ND	ND
ESMP-2D	3/28/96	2.0	ND	2.9	ND	ND	2.9	ND	ND	0.60	ND
ESMP-3S	3/28/96	ND	ND	0.40	ND	ND	0.40	ND	ND	ND	ND
ESMP-4S	3/28/96	ND	ND	0.70	ND	ND	0.70	ND	ND	ND	0.70
ESMP-5S	3/28/96	0.20	ND	0.70	ND	ND	0.70	ND	ND	ND	ND
ESMP-6S	3/29/96	ND	1.8	2.2	ND	ND	4.0	ND	ND	ND	ND
ESMP-6D	3/27/96	ND	ND	1.1	ND	ND	1.1	ND	ND	ND	ND
ESMP-7S	3/29/96	ND	ND	3.8	ND	ND	3.8	ND	ND	ND	ND
ESMP-8S	3/28/96	ND	ND	1.2	ND	ND	1.2	ND	ND	ND	ND
ESMP-9S	3/28/96	ND	ND	1.8	ND	ND	1.8	ND	ND	ND	ND
ESMP-19S	3/29/96	2.0	23	5.6	2.5	8.9	40	7.8	13	4.1	14
ESMP-20S	3/30/96	0.30	ND	2.9	ND	2.3	5.2	0.60	1.2	0.60	ND
ESMP-23D	3/29/96	32	11000	170	860	120	12150	ND	ND	ND	42
CPT-22	3/29/96	83	11000	11000	840	7800	30640	510	1700	510	160
TW-1102	3/27/96	0.30	0.40	3.2	0.50	3.0	7.1	0.50	1.6	0.80	ND
MW-1104	3/27/96	2.0	50	20	38	97	205	15	36	11	14
TW-1105	3/28/96	200	23000	44000	2900	15000	84900	640	2300	740	260
TW-1106	3/27/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TW-1109	3/27/96	13	2600	62	170	790	3622	ND	200	64	44
TW-1110	3/27/96	27	6300	230	620	510	7660	ND	70	ND	63
TW-1111	3/27/96	58	2300	4500	1400	8800	17000	530	1700	5300	160
MW-1116	3/26/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

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TABLE 4.3 (Concluded)
FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUNDWATER AND SURFACE WATER
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Sample Location	Sample Date	TVPH-Gasoline[a] (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Total BTEX (µg/L)	1,3,5-TMB (µg/L)	1,2,4-TMB (µg/L)	1,2,3-TMB (µg/L)	1,2,3,4,-Tetra (µg/L)
MW-1119	3/27/96	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-1120	3/26/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-1121	3/26/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-1122	3/26/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-1123	3/26/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-1124	3/26/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-1125	3/26/96	ND	1.0	ND	ND	ND	1.0	ND	ND	ND	ND
MW-1126	3/26/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-1127	3/26/96	0.10	35	ND	ND	0.40	35.4	ND	ND	0.50	ND
MW-1128	3/28/96	0.30	3.2	0.50	0.90	2.9	7.5	ND	0.90	ND	0.50
SUR1	3/29/96	NA[e]	ND	0.50	ND	ND	0.50	ND	ND	ND	ND
SUR2	3/29/96	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND
SUR3	3/29/96	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND

[a] TVPH-Gasoline = Total Volatile Petroleum Hydrocarbons, Gasoline Range.
[b] mg/L=Milligrams per liter.
[c] µg/L=Micrograms per liter.
[d] ND=Not Detected.
[e] NA=Not Available.

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highest measured BTEX compound at sampling location SED1 suggests that an unidentified contaminant source upstream of the site may exist. The low-level detection of BTEX compounds at sediment sampling location SED2 suggest that contamination emanating from the BX Shoppette may have once entered the drainage canal during a period of high groundwater level or from surface water runoff. Alternatively, the BTEX compounds detected at SED2 may have arisen from an unidentified upstream source or unidentified surface spill in the area.

4.5 GROUNDWATER CHEMISTRY

Three lines of evidence can be used to document the occurrence of natural attenuation: 1) geochemical evidence; 2) documented loss of contaminant mass at the field scale; and 3) microcosm studies. The first two lines of evidence (geochemical evidence and documented loss of contaminants) are used herein to support the occurrence of natural attenuation at the BX Shoppette, as described in the following sections. Because these two lines of evidence strongly suggest that natural attenuation is occurring at this site, a microcosm study was not deemed necessary.

4.5.1 Historic Measurements of Dissolved Hydrocarbon Contamination

Two groundwater sampling events conducted prior to March 1996 indicated the presence of fuel hydrocarbon contamination in the shallow groundwater beneath the BX Shoppette site. Groundwater samples were collected from 18 monitoring wells in January 1992 (TW-1101 through MW-1116, MW-1119, and MW-1120) (Halliburton NUS, 1992). The headspace associated with each of these groundwater samples was analyzed from BTEX concentration with an onsite portable GC. Headspace concentrations of a least 1 µg/L were detected for all 18 samples. On the basis of field screening results and optimal monitoring well placement, monitoring wells TW-1103, TW-1107, TW-1108, TW-1112, and TW-1113 were abandoned. Monitoring well TW-1108 was partially filled with concrete and has sufficient riser available to measure the presence of mobile LNAPL flowing into the well. The remaining monitoring wells were temporarily or permanently installed.

Monitoring wells TW-1101, TW-1102, TW-1105, TW-1106, and TW-1109 were originally intended for temporary groundwater level measurement or mobile LNAPL removal (TW-1105) before eventual abandonment. These five monitoring wells were still functional during the field work phase of this demonstration project in March 1996.

Monitoring wells MW-1104, TW-1110, TW-1111, MW-1114, TW-1115, MW-1116, MW-1119, and MW-1120 were intended for indefinite use and were provided with permanent completions. Samples from the eight permanent monitoring wells were submitted for laboratory analysis, and the results are summarized in tabular form in Appendix B. Six of the eight groundwater samples had nondetectable concentrations of BTEX compounds. Monitoring well TW-1110 and TW-1111 had high concentrations of BTEX at 59,700 μg/L and 13,920 μg/L, respectively. On the basis of groundwater analytical and soil-gas data, the extent of groundwater contamination appeared to center around the UST pit and cover approximately 360 feet in the northwest/southeast direction and 250 feet in the northeast/southwest direction.

Fifteen groundwater monitoring wells were sampled by Halliburton NUS (1996) from June through November 1995 to observe contaminant trends in the shallow aquifer and the sandy, semi-confined aquifer. Eight of the 15 sampled monitoring wells were installed between April and November 1995 (MW-1121 through MW-1128): three wells were completed in the shallow surficial aquifer (MW-1121 through MW-1123); five wells were completed in the semi-confined sandy aquifer (MW-1124 through MW-1128). BTEX compounds were detected in five of the shallow aquifer wells (TW-1101, MW-1104, TW-1109, TW-1110, and TW-1111), with the highest BTEX concentration of 36,900 μg/L detected at TW-1111 (June 1995). The areal extent of the 1995 BTEX plume was comparable to the areal extent of the 1992 BTEX plume. Groundwater BTEX concentrations increased between 1992 and 1995 at monitoring wells MW-1104 and TW-1111 (increases of 1,062 and 22,880 μg/L, respectively), suggesting the potential migration of mobile LNAPL and/or contaminated groundwater into areas north and east of the former tank pit. BTEX contamination was observed to decrease by approximately 45,220 μg/L at monitoring well TW-1110. BTEX contamination in the remaining shallow monitoring wells was below detectable limits.

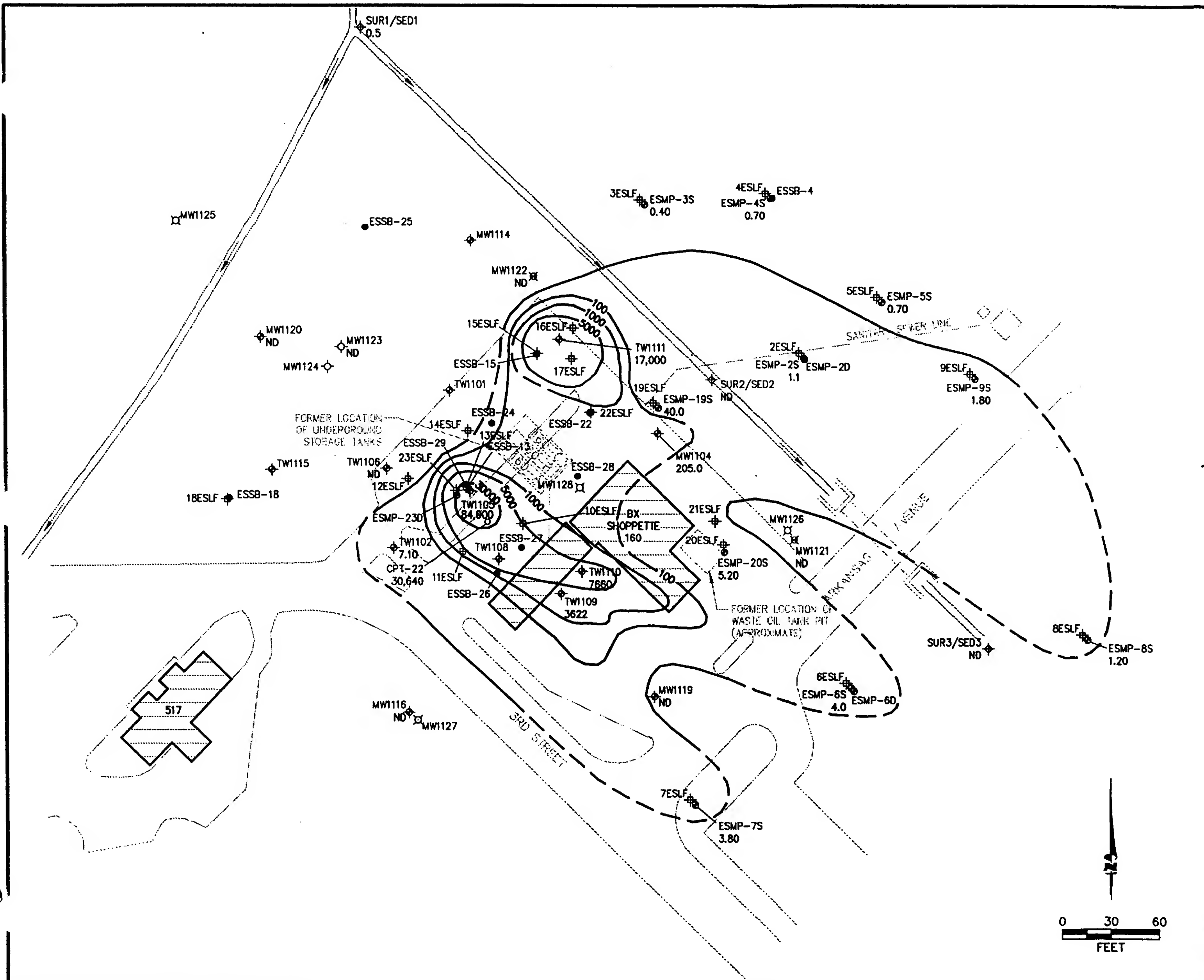
BTEX compounds were detected at two locations in the semi-confined sand aquifer in 1995. Monitoring well MW-1124 contained 81.9 μg/L of BTEX. Benzene was the only compound detected at monitoring well MW-1125 at a concentration of 40 μg/L. These results suggest that contaminated groundwater from above the aquitard has vertically migrated through the clay layer. → [illegible]

Groundwater data collected in March 1996 by Parsons ES indicates that the groundwater plume is larger than previously suspected. Tables 4.3 summarizes groundwater BTEX, TMB, TEMB, and TVPH results from the March 1996 sampling event. TMB and TEMB results are presented because they are water-soluble fuel constituents with sorptive properties similar to BTEX, but which are considered relatively recalcitrant to biological degradation under anaerobic conditions; therefore, they can be used as tracer compounds in the calculation of anaerobic decay rates, as presented in Section 5. Analytical results for the current investigation are discussed in the following subsections.

4.5.1.1 March 1996 BTEX Concentrations

The areal distribution of groundwater BTEX concentrations for the shallow aquifer for March 1996 is presented on Figure 4.5. As indicated by the 1-µg/L isopleth, the BTEX plume is approximately 420 feet in the northwest/southeast direction and 330 feet in the southwest/northeast direction. The 5,000-µg/L contours identify two source areas at the site north and southwest of the former UST pit. These source areas coincide in location with previous detections of mobile LNAPL (Section 4.2). Benzene and/or toluene appear to have migrated east past Arkansas Avenue and northeast past the southeast-flowing drainage canal, thus enlarging previous estimates on the extent of the BTEX plume (Section 4.5.1). The BTEX plume does not extend west of the source areas, as indicated by nondetectable concentrations of BTEX compounds at monitoring wells TW-1106, MW-1120, and MW-1122.

BTEX concentrations were detected in the semi-confined aquifer at monitoring wells MW-1125, MW-1127, and MW-1128 (Table 4.3). Monitoring well MW-1125 is the only well that had detectable groundwater contamination in both 1995 and 1996 (40 and 1 µg/L of benzene, respectively). Between 1995 and 1996, BTEX compounds disappeared at monitoring well MW-1124 and appeared at monitoring wells MW-1127 and MW-1128. A BTEX concentration of 12,150 µg/L was detected at ESMP-23D; however, this elevated concentrations is a result of LNAPL that was pulled from the shallow aquifer to the semi-confined aquifer during CPT operations. Therefore, the artificially introduced BTEX concentration at ESMP-23D was not used in the delineation of BTEX contamination in the semi-confined aquifer. The vertical migration of BTEX compounds to the sandy aquifer may be strongly influenced by seasonal variations of groundwater



LEGEND

MW1120	MONITORING WELL, INSTALLED DECEMBER 1991–JANUARY 1992
MW1121	MONITORING WELL, INSTALLED APRIL 1995
MW1123	MONITORING WELL, INSTALLED AUGUST 1995
MW1126	MONITORING WELL, INSTALLED OCTOBER 1995–NOVEMBER 1995
ESMP-25	MONITORING POINT, INSTALLED MARCH 1996
ESSB-18	SOIL BORING, MARCH 1996
18ESLF	CONE PENETROMETER/LASER INDUCED FLUORESCENCE (CPT/LIF) LOCATION, MARCH 1996
SUR1/SED1	SURFACE WATER (SUR) OR SEDIMENT (SED) SAMPLING LOCATION, MARCH 1996
100	LINE OF EQUAL BTEX CONCENTRATION ($\mu g/L$) (DASHED WHERE INFERRED) CONTOUR INTERVAL = VARIABLE
ND	NONDETECT
BTEX	BENZENE, TOLUENE, ETHYLBENZENE AND XYLENE
O	MONITORING WELL, INSTALLATION DATE UNKNOWN

FIGURE 4.5

TOTAL BTEX CONCENTRATIONS IN SHALLOW GROUNDWATER AND SURFACE WATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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flow direction and elevation that present opportunities for shallow dissolved contamination to migrate through the clay layer to the aquifer below.

Where detected, total BTEX concentrations range from 0.4 to 84,900 μg/L in March 1996 (Table 4.3). The maximum concentration of 84,900 μg/L was detected in a groundwater sample collected below mobile LNAPL in monitoring well TW-1105. On the basis of the work of Cline *et al.* (1991), the maximum dissolved BTEX concentration that can result from the equilibrium partitioning of BTEX compounds from fresh gasoline into groundwater is approximately 132,200 μg/L. Using the mass fraction of BTEX compounds in the LNAPL sample from well TW-1105, the maximum expected equilibrium partitioning of BTEX compounds into the groundwater is approximately 76,130-μg/L. LNAPL variability or LNAPL emulsification may account for the small difference in the maximum observed dissolved BTEX concentration and the theoretical maximum dissolved BTEX concentration. Equilibrium partitioning calculations are presented in Appendix C.

The maximum benzene, toluene, ethylbenzene, and total xylene concentrations of 23,000-μg/L, 44,000-μg/L, 2,900-μg/L, and 15,000-μg/L were all detected in the groundwater sample collected from monitoring point TW-1105. Detected groundwater benzene concentrations exceeded the federal maximum contaminant level (MCL) of 5.0 μg/L (USEPA, 1994) at eight locations in the shallow aquifer and 1 location in the semi-confined aquifer. Toluene concentrations exceeded the federal MCL of 1,000 μg/L at three locations in the shallow aquifer. Ethylbenzene exceeded the federal MCL of 700 μg/L at two locations in the shallow aquifer. Total xylenes exceeded the federal MCL of 10,000 μg/L at one location in the shallow aquifer.

4.5.1.2 Total Volatile Petroleum Hydrocarbon Concentrations

The distribution of TVPH (normalized to a gasoline standard) in groundwater is similar to the distribution of BTEX compounds in the vicinity of the BX Shoppette (Figure 4.6). However, the downgradient extent of TVPH contamination (east of the Shoppette) is less than for observed BTEX contamination. Dissolved volatile fuel hydrocarbons were detected at all but seven locations where dissolved BTEX compounds were detected and where TVPH was sampled. Fuel hydrocarbons were detected at only one location (MW-1119) where dissolved BTEX was not detected. Total detected TVPH concentrations ranged from 0.1 to 200 mg/L (Table 4.3). The analysis of TVPH

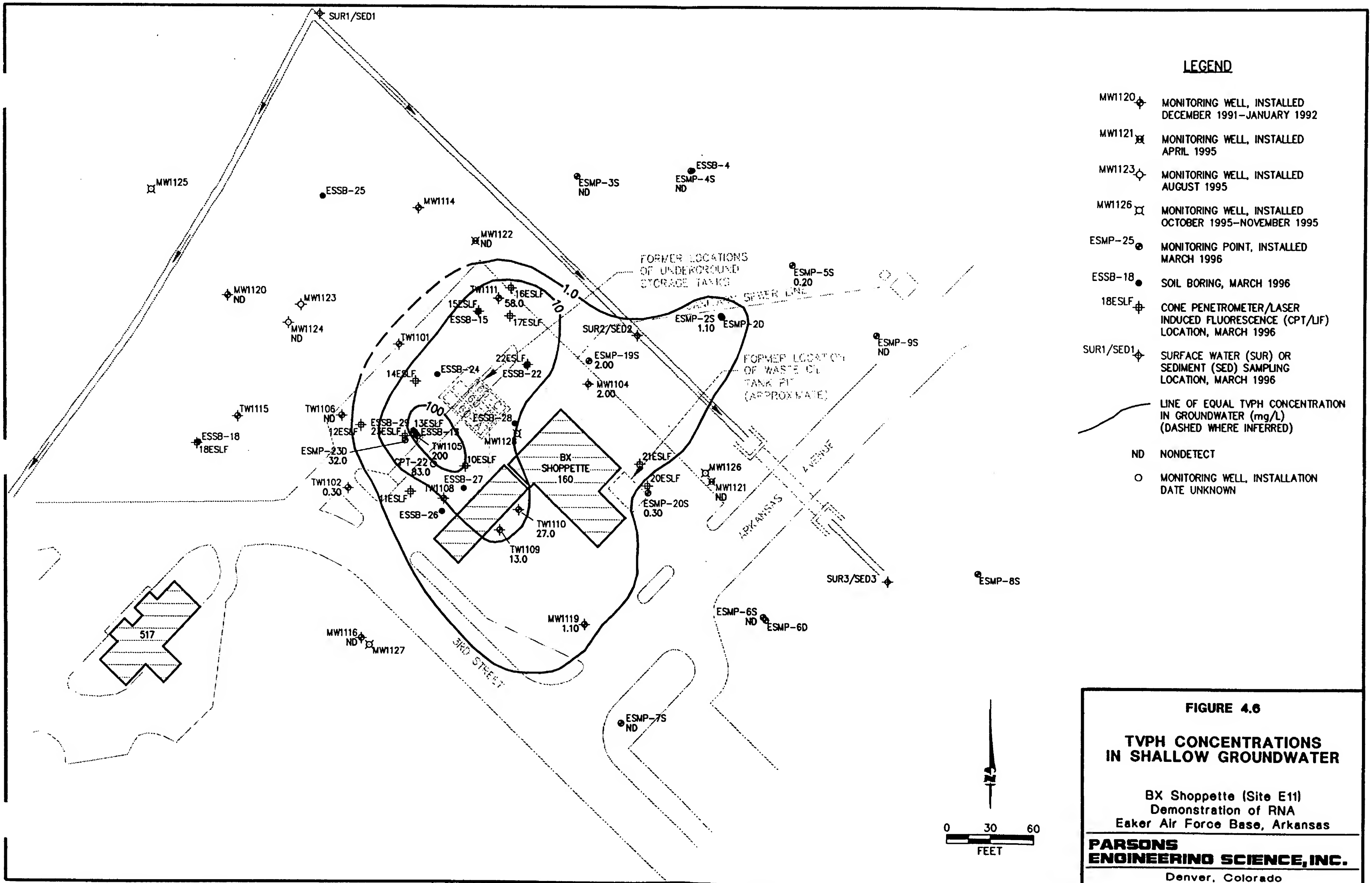

FIGURE 4.6

TVPH CONCENTRATIONS IN SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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concentrations provides a better estimate of the volatile aromatic, alicyclic, and aliphatic hydrocarbon mass present in gasoline than does analysis for BTEX.

4.5.2 Inorganic Chemistry and Geochemical Indicators of BTEX Biodegradation

Microorganisms obtain energy for cell production and maintenance by facilitating thermodynamically advantageous redox reactions involving the transfer of electrons from electron donors to available electron acceptors. This results in the oxidation of the electron donor and the reduction of the electron acceptor. Electron donors at the site are natural organic carbon and fuel hydrocarbon compounds. Fuel hydrocarbons are completely degraded or detoxified if they are utilized as the primary electron donor for microbial metabolism (Bouwer, 1992). Electron acceptors are elements or compounds that occur in relatively oxidized states, and include oxygen, nitrate, ferric iron, sulfate, manganese, and carbon dioxide.

The driving force of BTEX degradation is electron transfer, which is quantified by the Gibbs free energy of the reaction ($\Delta G°_r$) (Stumm and Morgan, 1981; Bouwer, 1994; Godsey, 1994). The value of $\Delta G°_r$ represents the quantity of free energy consumed or yielded to the system during the reaction. Table 4.4 lists stoichiometry of the redox equations involving BTEX and the resulting $\Delta G°_r$. Although thermodynamically favorable, most of the reactions involved in BTEX oxidation cannot proceed abiotically because of the lack of activation energy. Microorganisms are capable of providing the necessary activation energy; however, they will facilitate only those redox reactions that have a net yield of energy (i.e. $\Delta G°_r < 0$). Microorganisms preferentially utilize electron acceptors while metabolizing fuel hydrocarbons (Bouwer, 1992). DO is utilized first as the prime electron acceptor. After the DO is consumed, anaerobic microorganisms use electron acceptors in the following order of preference: nitrate, manganese, ferric iron hydroxide, sulfate, and finally carbon dioxide.

Depending on the types and concentrations of electron acceptors present (e.g., nitrate, sulfate, carbon dioxide), pH conditions, and redox potential, anaerobic biodegradation can occur by denitrification, manganese reduction, ferric iron reduction, sulfate reduction, or methanogenesis. Other, less common anaerobic degradation mechanisms such as nitrate reduction may dominate if the physical and chemical conditions in the subsurface favor these pathways. Anaerobic destruction of the BTEX compounds is associated with the accumulation of fatty acids, production of methane, solubilization of iron, and

TABLE 4.4
COUPLED OXIDATION REACTIONS FOR BTEX COMPOUNDS
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Coupled Benzene Oxidation Reactions	ΔG°_r (kcal/mole Benzene)	ΔG°_r (kJ/mole Benzene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$7.5O_2 + C_6H_6 \Rightarrow 6CO_{2,g} + 3H_2O$ *Benzene oxidation /aerobic respiration*	-765.34	-3202	3.07:1
$6NO_3^- + 6H^+ + C_6H_6 \Rightarrow 6CO_{2,g} + 6H_2O + 3N_{2,g}$ *Benzene oxidation / denitrification*	-775.75	-3245	4.77:1
$30H^+ + 15\underline{MnO_2} + C_6H_6 \Rightarrow 6CO_{2,g} + 15Mn^{2+} + 18H_2O$ *Benzene oxidation / manganese reduction*	-765.45	-3202	10.56:1
$3.75\ NO_3^- + C_6H_6 + 7.5\ H^+ + 0.75\ H_2O \Rightarrow 6\ CO_2 + 3.75\ NH_4^+$ *Benzene oxidation / nitrate reduction*	-524.1	-2193	2.98:1
$60H^+ + 30\underline{Fe(OH)_{3,a}} + C_6H_6 \Rightarrow 6CO_2 + 30Fe^{2+} + 78H_2O$ *Benzene oxidation / iron reduction*	-560.10	-2343	21.5:1 a/
$7.5H^+ + 3.75SO_4^{2-} + C_6H_6 \Rightarrow 6CO_{2,g} + 3.75H_2S^o + 3H_2O$ *Benzene oxidation / sulfate reduction*	-122.93	-514.3	4.61:1
$4.5H_2O + C_6H_6 \Rightarrow 2.25CO_{2,g} + 3.75CH_4$ *Benzene oxidation / methanogenesis*	-32.40	-135.6	0.77:1 b/

Coupled Toluene Oxidation Reactions	ΔG°_r (kcal/mole Toluene)	ΔG°_r (kJ/mole Toluene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$9O_2 + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4H_2O$ *Toluene oxidation /aerobic respiration*	-913.76	-3823	3.13:1
$7.2NO_3^- + 7.2H^+ + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 7.6H_2O + 3.6N_{2,g}$ *Toluene oxidation / denitrification*	-926.31	-3875	4.85:1
$36H^+ + 18\underline{MnO_2} + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 18Mn^{2+} + 22H_2O$ *Toluene oxidation / manganese reduction*	-913.89	-3824	10.74:1
$72H^+ + 36\underline{Fe(OH)_{3,a}} + C_6H_5CH_3 \Rightarrow 7CO_2 + 36Fe^{2+} + 94H_2O$ *Toluene oxidation / iron reduction*	-667.21	-2792	21.86:1 a/
$9H^+ + 4.5SO_4^{2-} + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4.5H_2S^o + 4H_2O$ *Toluene oxidation / sulfate reduction*	-142.86	-597.7	4.7:1
$5H_2O + C_6H_5CH_3 \Rightarrow 2.5CO_{2,g} + 4.5CH_4$ *Toluene oxidation / methanogenesis*	-34.08	-142.6	0.78:1 b/

TABLE 4.4 (CONCLUDED)
COUPLED OXIDATION REACTIONS FOR BTEX COMPOUNDS
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Coupled Ethylbenzene Oxidation reactions	$\Delta G°_r$ (kcal/mole Ethyl-benzene)	$\Delta G°_r$ (kJ/mole Ethyl-benzene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$10.5O_2 + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5H_2O$ *Ethylbenzene oxidation /aerobic respiration*	-1066.13	-4461	3.17:1
$8.4NO_3^- + 8.4H^+ + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 9.2H_2O + 4.2N_{2,g}$ *Ethylbenzene oxidation / denitrification*	-1080.76	-4522	4.92:1
$46H^+ + 22\underline{MnO_2} + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 22Mn^{2+} + 28H_2O$ *Ethylbenzene oxidation / manganese reduction*	-1066.27	-4461	11.39:1
$84H^+ + 42\underline{Fe(OH)_{3,a}} + C_6H_5C_2H_5 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ *Ethylbenzene oxidation / iron reduction*	-778.48	-3257	22:1[a/]
$10.5H^+ + 5.25SO_4^{2-} + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5.25H_2S^o + 5H_2O$ *Eth ylbenzene oxidation / sulfate reduction*	-166.75	-697.7	4.75:1
$5.5H_2O + C_6H_5C_2H_5 \Rightarrow 2.75CO_{2,g} + 5.25CH_4$ *Ethylbenzene oxidation / methanogenesis*	-39.83	-166.7	0.79:1 [b/]

Coupled m-Xylene Oxidation Reactions	$\Delta G°_r$ (kcal/mole *m*-xylene)	$\Delta G°_r$ (kJ/mole *m*-xylene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$10.5O_2 + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5H_2O$ *m-Xylene oxidation /aerobic respiration*	-1063.25	-4448	3.17:1
$8.4NO_3^- + 8.4H^+ + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 9.2H_2O + 4.2N_{2,g}$ *m-Xylene oxidation / denitrification*	-1077.81	-4509	4.92:1
$46H^+ + 22MnO_2 + C_6H_4(CH_3)_2 \Rightarrow 8CO_2 + 22Mn^{2+} + 28H_2O$ *m-Xylene oxidation / manganese reduction*	-1063.39	-4449	11.39:1
$84H^+ + 42\underline{Fe(OH)_{3,a}} + C_6H_4(CH_3)_2 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ *m-Xylene oxidation / iron reduction*	-775.61	-3245	22:1[a/]
$10.5H^+ + 5.25SO_4^{2-} + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5.25H_2S^o + 5H_2O$ *m-Xylene oxidation / sulfate reduction*	-163.87	-685.6	4.75:1
$5.5H_2O + C_6H_4(CH_3)_2 \Rightarrow 2.75CO_{2,g} + 5.25CH_4$ *m-Xylene oxidation / methanogenesis*	-36.95	-154.6	0.79:1 [b/]

[a/] Mass of ferrous iron produced during microbial respiration.

[b/] Mass of methane produced during microbial respiration.

reduction of nitrate and sulfate (Cozzarelli *et al.*, 1990; Wilson *et al.*, 1990). Environmental conditions and microbial competition ultimately determine which processes will dominate. Vroblesky and Chapelle (1994) show that the dominant terminal electron accepting process can vary both temporally and spatially in an aquifer with fuel hydrocarbon contamination.

Site groundwater data for DO suggest that RNA of hydrocarbons in the shallow aquifer is occurring by aerobic biodegradation. In addition, data for soluble manganese (Mn^{2+}), ferrous iron (Fe^{2+}), sulfate, and methane suggest that anaerobic degradation via manganese reduction, ferric iron reduction, sulfate reduction, and methanogenesis is occurring. Because both site and background concentrations of nitrate are very low, denitrification is not believed to contribute significantly to the attenuation of BTEX in site groundwater. Geochemical parameters for site groundwater are discussed in the following sections.

4.5.2.1 Dissolved Oxygen

DO concentrations were measured at monitoring wells and points during the March 1996 sampling event. Table 4.5 summarizes measured DO concentrations. In the shallow aquifer, concentrations ranged from 0.4 to 8.2 mg/L with lowest DO concentrations (<1.0 mg/L) located in the vicinity of the mobile LNAPL and the highest DO concentrations beyond the extent of the 100-µg/L BTEX isopleth (Figure 4.5). This trend suggests that DO is a moderately important electron acceptor at the site. Figure 4.7 presents an isopleth map for DO concentrations in the shallow aquifer. DO concentrations in the semi-confined aquifer ranged from 0.3 to 2.4 mg/L. Although, locations with detected BTEX concentrations also had low (<1.0 mg/L) DO concentrations, some background locations had similarly low DO concentrations.

The stoichiometry of BTEX mineralization to carbon dioxide and water caused by aerobic microbial biodegradation is presented in Table 4.4. The average mass ratio of oxygen to total BTEX is approximately 3.14 to 1. This translates to the mineralization of approximately 0.32 mg of BTEX for every 1.0 mg of DO consumed. With an average shallow groundwater background DO concentration (defined by locations ESMP-7S, MW-1116, ESMP-3S, and MW-1114) of approximately 6.2 mg/L and DO concentrations in the source area of approximately 0.4 mg/L, the shallow groundwater at this site has the capacity to assimilate approximately $\boxed{\text{1.86 mg/L}}$ (1,860 µg/L) of total BTEX through

1.25

 to 1.98 (1,980 µg/L) gst.

TABLE 4.5
GEOCHEMICAL DATA FOR GROUNDWATER
BX SHOPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Sampling Location	Sample Date	Temp. (°C)[a/]	pH (SU)[b/]	Redox (mV)[c/]	Cond. (µs/cm)[d/]	Dissolved Oxygen (mg/L)[e/]	Cl^- (mg/L)	Fe^{2+} (mg/L)	$Fe^{2+}+Fe^{3+}$ (mg/L)	SO_4^{2-} (mg/L)	S^{2-} (mg/L)	Mn^{2+} (mg/L)	NO_3^--N (mg/L)	CO_2 (mg/L)	Alkalinity (mg/L)	CH_4 (mg/L)
ESMP-2S	3/30/96	11.6	NA[f/]	156.2	NA	5.55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ESMP-2D	3/28/96	12.9	5.5	12.8	NA	NA	3.1	6.2	9.7	44.8	0.313	ND[g/]	0.064	50	140	0.095
ESMP-3S	3/28/96	11.2	5	71.2	NA	4.21	5.2	0.35	3.92	14.2	NA	ND	<0.056	NA	NA	ND
ESMP-4S	3/28/96	10.7	5.5	10.2	NA	2.76	4.5	0.6	1.24	23.1	NA	1.3	<0.056	20	180	ND
ESMP-5S	3/28/96	10.3	5	160.3	NA	7.22	7.4	ND	1.38	77.8	NA	ND	0.059	40	260	ND
ESMP-6S	3/29/96	NA	5	NA	NA	NA	6.5	0.35	1.75	14.9	NA	ND	0.11	NA	80	ND
ESMP-6D	3/27/96	15.5	5.5	-47	NA	2.4	10.3	4.9	7.45	80.4	0.089	1.5	0.12	30	140	0.007
ESMP-7S	3/30/96	13.3	5.5	10.2	NA	6.53	4.6	3.42	4.15	15.2	0.056	2.9	<0.056	NA	240	0.5
ESMP-8S	3/28/96	10.5	5.5	173.6	NA	3.35	5.8	0.06	0.26	30.6	0.11	ND	0.28	40	240	ND
ESMP-9S	3/28/96	10.9	5.5	116.3	NA	3.5	3.5	ND	1.02	15.3	NA	0.1	0.12	NA	120	ND
ESMP-19S	3/29/96	12.9	6	165	NA	4.41	7.3	0.16	0.27	18.3	NA	2.8	0.085	70	240	0.003
ESMP-20S	3/30/96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ESMP-22S	3/29/96	NA	6	NA	NA	NA	60.5	17.7	24.9	0.98	0.052	2.3	<0.056	210	400	1.5
ESMP-23D	3/29/96	17.2	6	-114	NA	0.33	19	21.85	38.7	1.8	0.03	3.3	0.75	220	520	3
TW-1102	3/27/96	17.5	6	147.8	NA	2.26	8.8	0.13	0.55	38.4	0.1511[h/]	0.6	0.074	100	300	ND
MW-1104	3/27/96	15.9	6	33.7	660	1.6	10.1	2.68	2.94	21.6	0.238I	1.3	0.058	240	340	0.036
TW-1105	3/28/96	16.5	6	0.9	NA	0.56	7	4.6	8.4	0.32	0.035	3	<0.056	250	460	3.8
TW-1106	3/27/96	16.4	5.5	118.5	NA	3.63	4.6	0.22	0.51	14.6	0.172I	0.7	0.07	120	300	0.004
TW-1109	3/27/96	17.4	6	-109.9	890	0.41	40.2	19.9	29.4	15.4	0.102	3	<0.056	210	400	1
TW-1110	3/27/96	17.3	6	-113.5	141	0.39	206	33.8	<51.0	1.5	0.065	2.7	<0.056	350	480	2.6
TW-1111	3/27/96	16.3	5.5	-46	NA	2.22	6	0.82	0.94	1.5	0.163	0.8	0.065	200	200	0.091
MW-1114	3/26/96	10.3	5	222.1	150	8.21	NA	0.07	0.53	NA	.161I	ND	NA	50	60	NA
MW-1116	3/26/96	13.1	5	137	320	5.93	5	0.02	0.18	44.4	0.09	ND	0.46	50	100	ND
MW-1119	3/27/96	14	6	0.3	154	3.22	12.1	3.95	4.8	70.5	0.009	10.8	0.058	170	780	0.092
MW-1120	3/26/96	11	6	100.1	490	2.97	2.7	ND	0.06	19.7	0.056	0.7	0.073	50	260	ND
MW-1121	3/27/96	12.7	5	134	210	6.18	4.7	0.07	0.18	15.9	0.099	ND	0.43	100	80	ND

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TABLE 4.5 (Concluded)
GEOCHEMICAL DATA FOR GROUNDWATER
BX SHOPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Sampling Location	Sample Date	Temp. (°C)[a]	pH (SU)[b]	Redox (mV)[c]	Cond. (µs/cm)[d]	Dissolved Oxygen (mg/L)[e]	Cl^- (mg/L)	Fe^{2+} (mg/L)	Fe^{2+}+Fe^{3+} (mg/L)	SO_4^{2-} (mg/L)	S^{2-} (mg/L)	Mn^{2+} (mg/L)	NO_3^--N (mg/L)	CO_2 (mg/L)	Alkalinity (mg/L)	CH_4 (mg/L)
MW-1122	3/26/96	11.8	5.5	172.9	200	4.3	5.7	0.02	0.13	27.2	0.058	ND	0.12	80	80	ND
MW-1123	3/26/96	13.2	6	88.6	370	4.19	4	0.04	0.21	13.9	0.079	0.05	0.13	70	160	ND
MW-1124	3/26/96	14.1	6	-4.1	370	1.4	4.9	5.45	8.85	29.8	0.042	0.8	<0.056	110	160	0.026
MW-1125	3/26/96	14.7	6	-6.6	580	1.01	3.6	6.25	7.9	89.1	0.034	0.5	<0.056	80	220	0.003
MW-1126	3/26/96	14.9	5.5	12.7	400	0.5	7.3	2.3	2.45	26.2	0.091	1.7	<0.056	60	160	0.006
MW-1127	3/25/96	16.3	6	-235	570	0.54	4.2	7.65	12.55	10	0.155	1.4	<0.056	110	320	ND
MW-1128	3/28/96	17.5	5.5-6.0	-51	NA	0.43	12.8	8.2	13.6	29.8	0.019	1.1	<0.056	70	240	0.14

[a] °C=Degrees Celsius.
[b] SU=Standard Units.
[c] mV=millivolts.
[d] µs/cm=Microsiemens per centimeter.
[e] mg/L=Milligrams per Liter.
[f] NA - Not analyzed for
[g] ND - Not detected in sample
[h] I - Silt Interference, value is questionable

Note: Cl^-=Chloride.
Fe^{2+}=Ferrous Iron.
Fe^{3+}=Ferric Iron.
SO_4^{2-}=Sulfate.
S_2^-=Sulfide.
Mn^{2+}=Manganese.
NO_3^--N=Nitrate nitrogen.
CO_2=Carbon dioxide.
CH_4=Methane.

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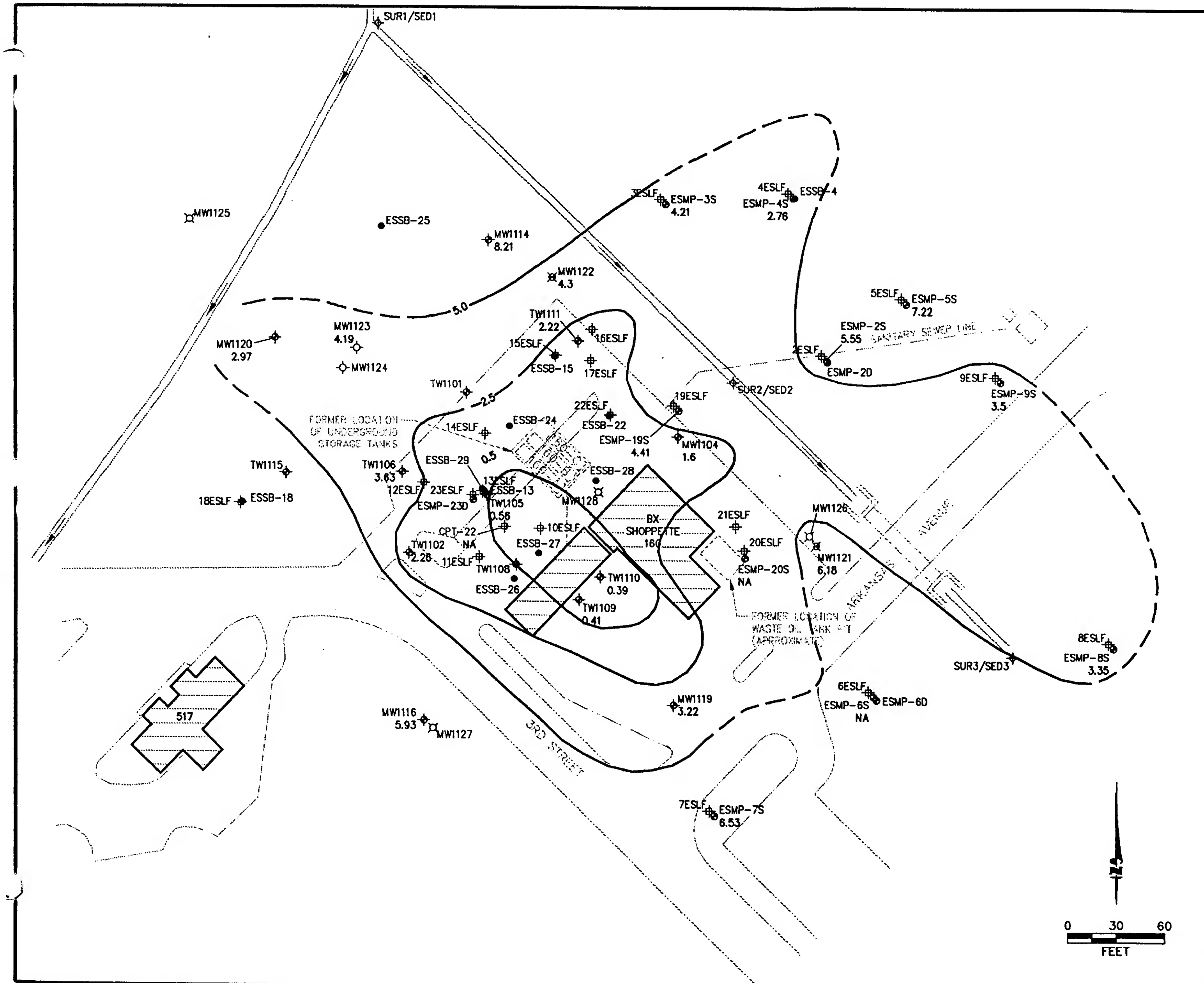

LEGEND

MW1120	MONITORING WELL, INSTALLED DECEMBER 1991–JANUARY 1992
MW1121	MONITORING WELL, INSTALLED APRIL 1995
MW1123	MONITORING WELL, INSTALLED AUGUST 1995
MW1126	MONITORING WELL, INSTALLED OCTOBER 1995–NOVEMBER 1995
ESMP-25	MONITORING POINT, INSTALLED MARCH 1996
ESSB-18	SOIL BORING, MARCH 1996
18ESLF	CONE PENETROMETER/LASER INDUCED FLUORESCENCE (CPT/LIF) LOCATION, MARCH 1996
SUR1/SED1	SURFACE WATER (SUR) OR SEDIMENT (SED) SAMPLING LOCATION, MARCH 1996
3	LINE OF EQUAL DISSOLVED OXYGEN CONCENTRATION (mg/L) (DASHED WHERE INFERRED) CONTOUR INTERVAL = VARIABLE
NA	NOT ANALYZED

FIGURE 4.7

DISSOLVED OXYGEN ISOPLETH MAP FOR SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

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aerobic biodegradation. Because the background DO varies in the semi-confined aquifer, the capacity of the deeper groundwater to aerobically degrade BTEX is conservatively assumed to be 0 mg/L. The shallow groundwater assimilative capacity of DO is a conservative estimate because the recharge of oxygen through rainwater infiltration at the plume periphery (where surface paving is not present) has not been considered.

As a microbial population in the groundwater grows in response to the introduction of fuel hydrocarbons into the groundwater, new cell mass is generated. When cell mass production is accounted for, the mineralization of benzene to carbon dioxide and water is given by:

$$C_6H_6 + 2.5O_2 + HCO_3 + NH_4 \rightarrow C_5H_7O_2N + 2CO_2 + 2H_2O$$

This equation indicates that 5.0 fewer moles of DO are required to mineralize 1 mole of benzene when cell mass production is taken into account. On a mass basis, the ratio of DO to benzene is given by:

Benzene	6(12) + 1(6) = 78 gm
Oxygen	2.5(32)= 80 gm

Mass Ratio of Oxygen to Benzene = 80/78 = 1.03:1

On the basis of these stoichiometric relationships, 1.03 mg of oxygen are required to mineralize 1 mg of benzene, if cell mass production is taken into account. Similar calculations can be made for toluene, ethylbenzene, and the xylenes. On the basis of these calculations, approximately 0.97 mg of BTEX is mineralized to carbon dioxide and water for every 1.0 mg of DO consumed.

Although this process results in more efficient utilization of electron receptors, it is only applicable as the net cell mass of the microbial population continues to grow. Because groundwater contamination has been present at the BX Shoppette site for several years, it is expected that biomass mass production is only a small percentage of the overall energy use because the assimilation of BTEX has reached steady-state. Therefore, the cell mass reaction equations would no longer apply, and the assimilative capacity estimate based on no biomass production is considered more accurate. The steady-state production of cell mass as applied to anaerobic mechanisms is also likely, and the following calculations of anaerobic assimilative capacity estimates assume

steady-state conditions (i.e., biomass production represents a very small fraction of energy use).

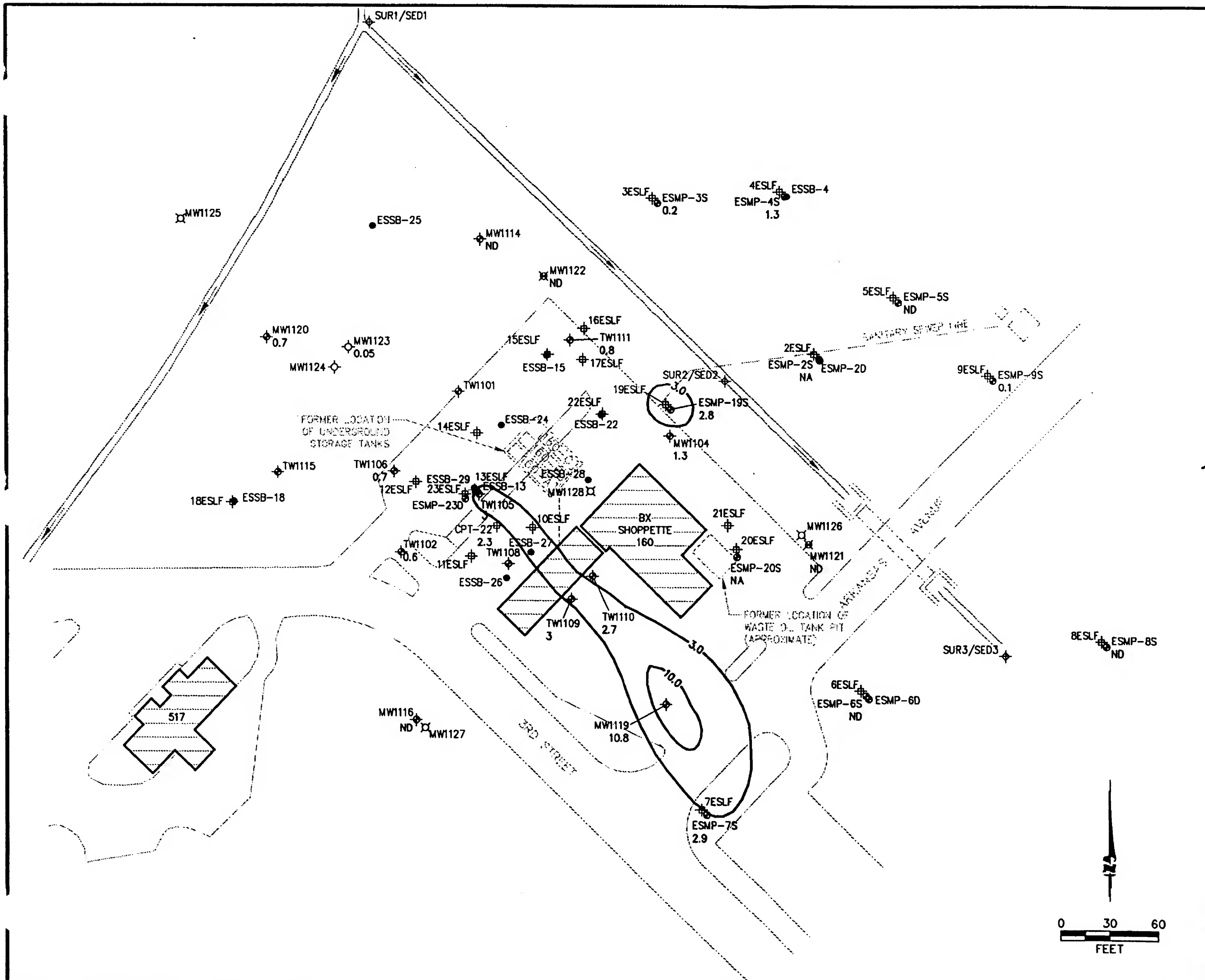
4.5.2.2 Nitrate/Nitrite

Concentrations of nitrate/nitrite [as nitrogen (N)] were measured in groundwater samples collected in March 1996. Table 4.5 summarizes measured nitrate (as N) concentrations. Nitrate concentrations ranged between 0.003 and 0.46 mg/L for the shallow groundwater, and 0.064 and 0.75 for the lower aquifer. Nitrite was not detected at any of the sampling locations.

In the absence of microbial cell production, the stoichiometry of BTEX mineralization to carbon dioxide, water, and nitrogen caused by denitrification is presented in Table 4.4. The average mass ratio of nitrate to total BTEX is approximately 4.9 to 1. This translates to the mineralization of approximately 0.20 mg of BTEX for every 1.0 mg of nitrate consumed. At all wells and monitoring points, nitrate/nitrite (as N) either was not detected above quantitation limits or was detected at trace concentrations. Based on the low nitrate/nitrite (as N) concentrations in groundwater and the absence of definitive trends in nitrate reduction, nitrate is not considered to be an important electron acceptor at this site in either the shallow surficial aquifer or the semi-confined aquifer.

4.5.2.3 Soluble Manganese

Soluble manganese (Mn^{2+}) concentrations were measured in groundwater samples collected in March 1996. Table 4.5 summarizes soluble manganese concentrations, which ranged from below instrument detection limits to 10.8 mg/L in the groundwater samples collected from the surficial aquifer. Figure 4.8 is an isopleth map showing the areal extent of soluble manganese in shallow groundwater. Comparison of Figure 4.8 and 4.5 shows graphically that soluble manganese is elevated above 1 mg/L within and southeast from the areas with the highest BTEX concentrations. Shallow groundwater soluble manganese concentrations were most elevated in the downgradient southeast portion of the plume (near MW-1119). Background concentrations of soluble manganese in the aquifer are generally less than 0.2 mg/L. Soluble manganese concentrations ranged between 0.5 and 3.3 for the semi-confined aquifer with the highest concentration detected in the source area in the groundwater samples collected from ESMP-23D.



LEGEND

MW1120	MONITORING WELL, INSTALLED DECEMBER 1991–JANUARY 1992
MW1121	MONITORING WELL, INSTALLED APRIL 1995
MW1123	MONITORING WELL, INSTALLED AUGUST 1995
MW1126	MONITORING WELL, INSTALLED OCTOBER 1995–NOVEMBER 1995
ESMP-25	MONITORING POINT, INSTALLED MARCH 1996
ESSB-18	SOIL BORING, MARCH 1996
18ESLF	CONE PENETROMETER/LASER INDUCED FLUORESCENCE (CPT/LIF) LOCATION, MARCH 1996
SUR1/SED1	SURFACE WATER (SUR) OR SEDIMENT (SED) SAMPLING LOCATION, MARCH 1996
3.0	LINE OF EQUAL MANGANESE CONCENTRATION (mg/L) CONTOUR INTERVAL = VARIABLE
ND	NONDETECT
NA	NOT ANALYZED

FIGURE 4.8

MANGANESE ISOPLETH MAP FOR SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

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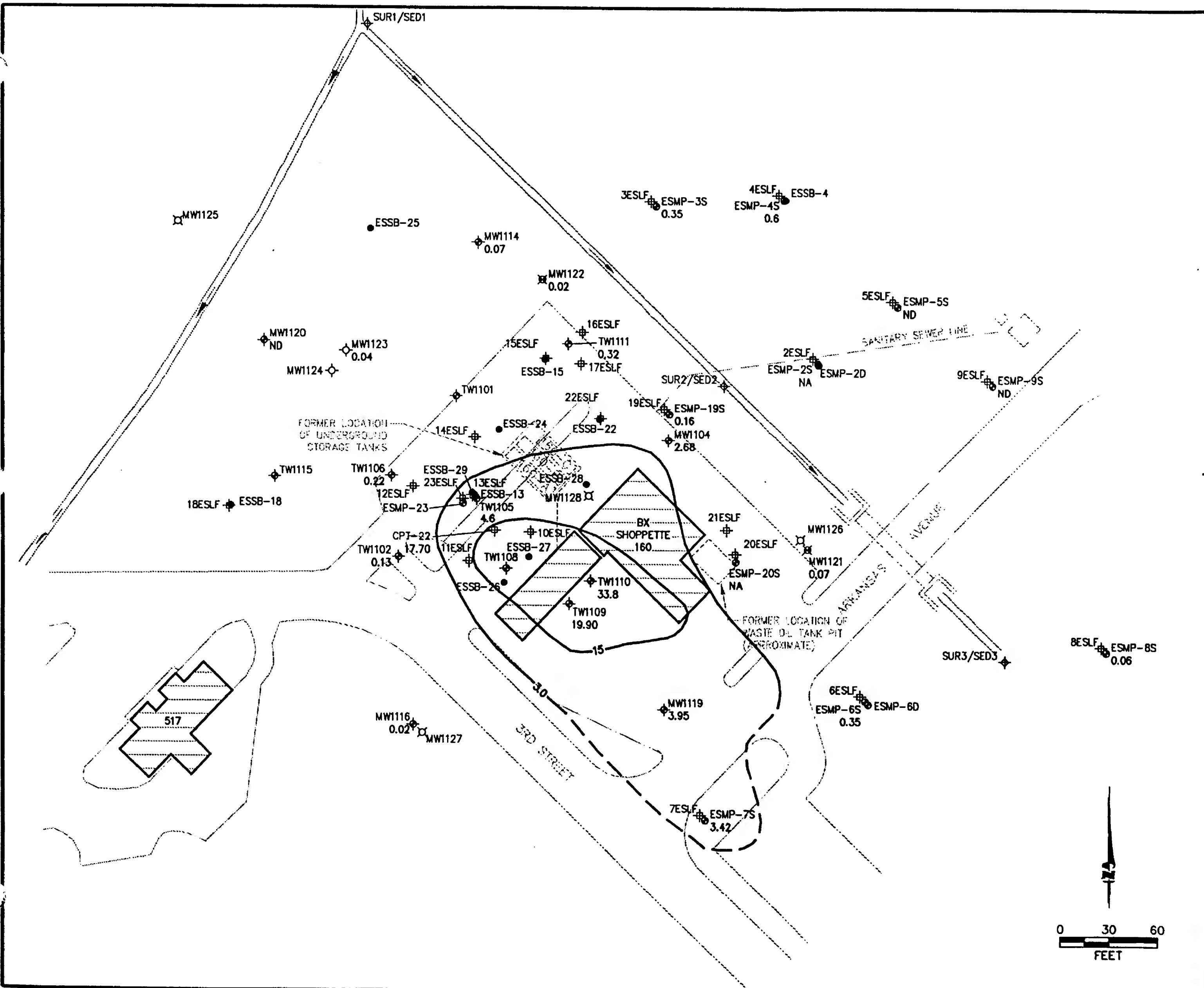
The stoichiometry of BTEX oxidation to carbon dioxide, soluble manganese, and water by manganese reduction through anaerobic microbial biodegradation is presented in Table 4.4. On average, 19 moles of manganese are required to metabolize one mole of total BTEX. Conversely, an average of 19 moles of soluble manganese are produced for each mole of total BTEX consumed. On a mass basis, this translates to approximately 11 mg of soluble manganese produced for each 1 mg of total BTEX metabolized. Given a background soluble manganese concentration of approximately 0.2 mg/L and a maximum detected soluble manganese concentration in the source area of 10.8 mg/L, the shallow groundwater has the capacity to assimilate approximately 0.96 mg/L (960 µg/L) of total BTEX through manganese reduction. In the semi-confined aquifer, a background soluble manganese concentration of 0.5 mg/L and a maximum detected soluble manganese concentration in the source area of 3.3 mg/L were used to estimate a semi-confined aquifer assimilative capacity of approximately 0.25 mg/L (250 µg/L) of total BTEX through manganese reduction. These assimilative capacities are conservative estimates because calculations are based on observed soluble manganese concentrations and not on the amount of manganese dioxide available in the aquifer. Therefore, BTEX assimilative capacity through this process could be much higher.

4.5.2.4 Ferrous Iron

Ferrous iron (Fe^{2+}) concentrations were measured in groundwater samples collected in March 1996. Table 4.5 summarizes ferrous iron concentrations. Measured ferrous iron concentrations range from below instrument detection limits to 33.8 mg/L in shallow groundwater. Figure 4.9 is an isopleth map showing the areal extent of ferrous iron in shallow groundwater. Comparison of Figures 4.9, 4.5, and 4.1 shows graphically that the area of elevated ferrous iron concentration coincides with the area of mobile LNAPL and extends to the southeast like the dissolved BTEX plume. This suggests that ferric iron hydroxide (Fe^{3+}) is being reduced to ferrous iron during biodegradation of fuel hydrocarbons. Background concentrations of ferrous iron appear to be 0.04 mg/L or less in the shallow groundwater. Despite the absence of BTEX, elevated ferrous iron concentrations were detected southwest of the BX Shoppette at monitoring well MW-1119, just downgradient from one of the suspected source areas. This trend suggests that a ferrous iron shadow" may be traveling ahead of the BTEX plume with unretarded advective groundwater flow. Ferrous iron concentrations were detected over a range of 2.3 to 21.9 mg/L in samples collected from the semi-confined aquifer. The highest



LEGEND

MW1120	MONITORING WELL, INSTALLED DECEMBER 1991–JANUARY 1992
MW1121	MONITORING WELL, INSTALLED APRIL 1995
MW1123	MONITORING WELL, INSTALLED AUGUST 1995
MW1126	MONITORING WELL, INSTALLED OCTOBER 1995–NOVEMBER 1995
ESMP-25	MONITORING POINT, INSTALLED MARCH 1996
ESSB-18	SOIL BORING, MARCH 1996
18ESLF	CONE PENETROMETER/LASER INDUCED FLUORESCENCE (CPT/LIF) LOCATION, MARCH 1996
SUR1/SED1	SURFACE WATER (SUR) OR SEDIMENT (SED) SAMPLING LOCATION, MARCH 1996
3.0	LINE OF EQUAL FERROUS IRON CONCENTRATION (mg/L) (DASHED WHERE INFERRED) CONTOUR INTERVAL = VARIABLE
ND	NONDETECT
NA	NOT ANALYZED

FIGURE 4.9

FERROUS IRON ISOPLETH MAP FOR SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

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Denver, Colorado

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concentration was detected in ESMP-23D, the same location as the highest dissolved BTEX concentration observed in the semi-confined aquifer.

The stoichiometry of BTEX oxidation to carbon dioxide, ferrous iron, and water by iron reduction through anaerobic microbial biodegradation is presented in Table 4.4. On average, 37.5 moles of ferric iron hydroxide are required to metabolize one mole of total BTEX. Conversely, an average of 37.5 moles of ferrous iron are produced for each mole of total BTEX consumed. On a mass basis, this translates to approximately 21.8 mg ferrous iron produced for each 1 mg of total BTEX metabolized. Given a background ferrous iron concentration of approximately 0.02 mg/L and a maximum detected ferrous iron concentration of 33.8 mg/L, the shallow groundwater has the capacity to assimilate approximately 1.55 mg/L (1,550 µg/L) of total BTEX through iron reduction. Assuming a background ferrous iron concentration of approximately 2.3 mg/L and a maximum detected ferrous iron concentration of 21.9 mg/L, the deep groundwater has the capacity to assimilate approximately 0.90 mg/L (900 µg/L) of total BTEX through iron reduction. These are conservative estimates of the assimilative capacity of iron because calculations are based on observed ferrous iron concentrations and not on the amount of ferric hydroxide available in the aquifer and solid soil matrix. Therefore, iron assimilative capacity could be much higher for both the shallow surficial aquifer and the semi-confined aquifer.

Evidence suggests that the reduction of ferric iron to ferrous iron cannot proceed at all without microbial mediation (Lovley and Phillips, 1988; Lovley *et al.,* 1991; Chapelle, 1993). None of the common organic compounds found in low-temperature, neutral, reducing groundwater could reduce ferric oxyhydroxides to ferrous iron under sterile laboratory conditions (Lovley *et al.,* 1991). This means that the reduction of ferric iron requires microbial mediation by microorganisms with the appropriate enzymatic capabilities. Because the reduction of ferric iron cannot proceed without microbial intervention, the elevated concentrations of ferrous iron that were measured in the contaminated groundwater at the site are very strong indicators of microbial activity.

4.5.2.5 Sulfate

Sulfate concentrations were measured in groundwater samples collected in March 1996. Sulfate concentrations at the site ranged from 0.32 mg/L to 44.4 mg/L in the shallow aquifer, and from 1.8 mg/L to 89.1 mg/L in the semi-confined aquifer.

Table 4.5 summarizes measured sulfate concentrations. Figure 4.10 is an isopleth map showing the areal extent of sulfate in shallow groundwater. Comparison of Figures 4.10 and 4.5 shows graphically that the area of depleted sulfate concentrations, as defined by the 15 mg/L isopleth, substantially overlaps the BTEX plume. In addition, the lowest sulfate concentration in the shallow groundwater was detected at TW-1105 where mobile LNAPL also was measured. Likewise, the lowest sulfate concentration in the semi-confined aquifer was detected at ESMP-23D, the same sampling location where the highest concentration of dissolved BTEX was observed in the semi-confined aquifer. These relationships are a strong indication that anaerobic biodegradation of BTEX compounds is occurring in the shallow groundwater through the microbially mediated process of sulfate reduction.

The stoichiometry of BTEX mineralization to carbon dioxide, sulfur, and water by sulfate reduction through anaerobic microbial biodegradation is presented in Table 4.4. The average mass ratio of sulfate to total BTEX is approximately 4.7 to 1. This translates to the mineralization of approximately 0.21 mg of total BTEX for every 1.0 mg of sulfate consumed. Shallow sulfate concentrations at two locations upgradient from the dissolved BTEX plume ranged from 27.2 mg/L to 44.4 mg/L, with an average concentration of 35.8 mg/L. Assuming a background sulfate concentration of 35.8 mg/L and a minimum sulfate concentration in the source area of 0.32 mg/L, the shallow groundwater at this site has the capacity to assimilate 7.45 mg/L (7,450 µg/L) of total BTEX through sulfate reduction. In addition, the groundwater from the semi-confined aquifer has the capacity to assimilate 13.7 mg/L (13,700 µg/L) of total BTEX, assuming an average background sulfate concentration of 67.0 mg/L (using MW-1125 and ESMP-2D) and a minimum sulfate concentration in the source area of 1.8 mg/L.

4.5.2.6 Methane in Groundwater

Methane concentrations were measured in groundwater samples collected in March 1996. Table 4.5 summarizes methane concentrations, which ranged from below the method detection limit to 3.8 mg/L in shallow groundwater 3.0 mg/L in deeper semi-confined groundwater. Figure 4.11 is an isopleth map showing the distribution of methane in shallow groundwater. Comparison of Figures 4.11 and 4.5 shows graphically that elevated methane concentrations (1.0 mg/L or greater) coincide with the southern area of high dissolved BTEX concentrations (greater than 1,000 µg/L). In addition, the highest methane concentration in the shallow groundwater was detected at TW-1105

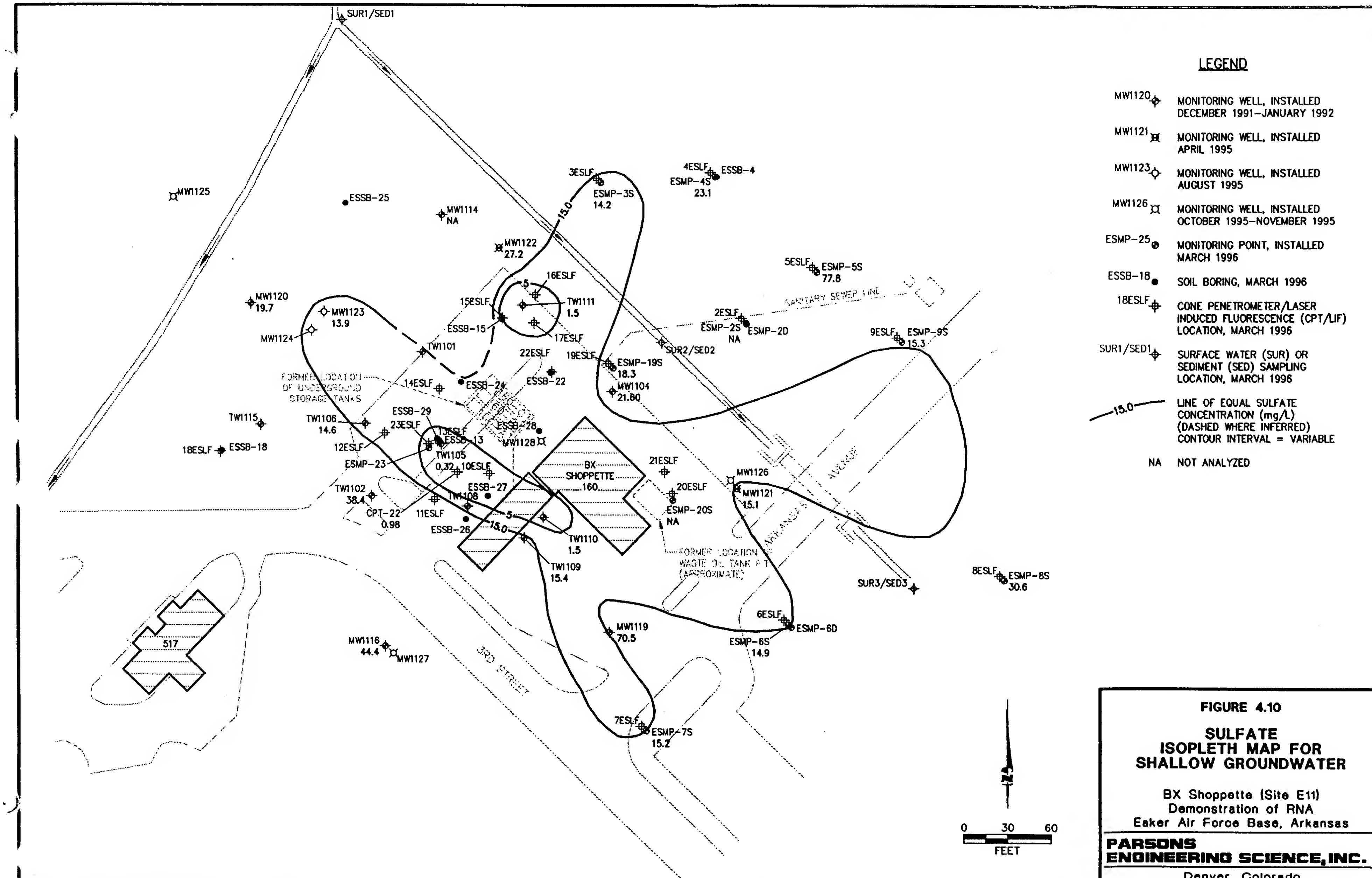

FIGURE 4.10

SULFATE ISOPLETH MAP FOR SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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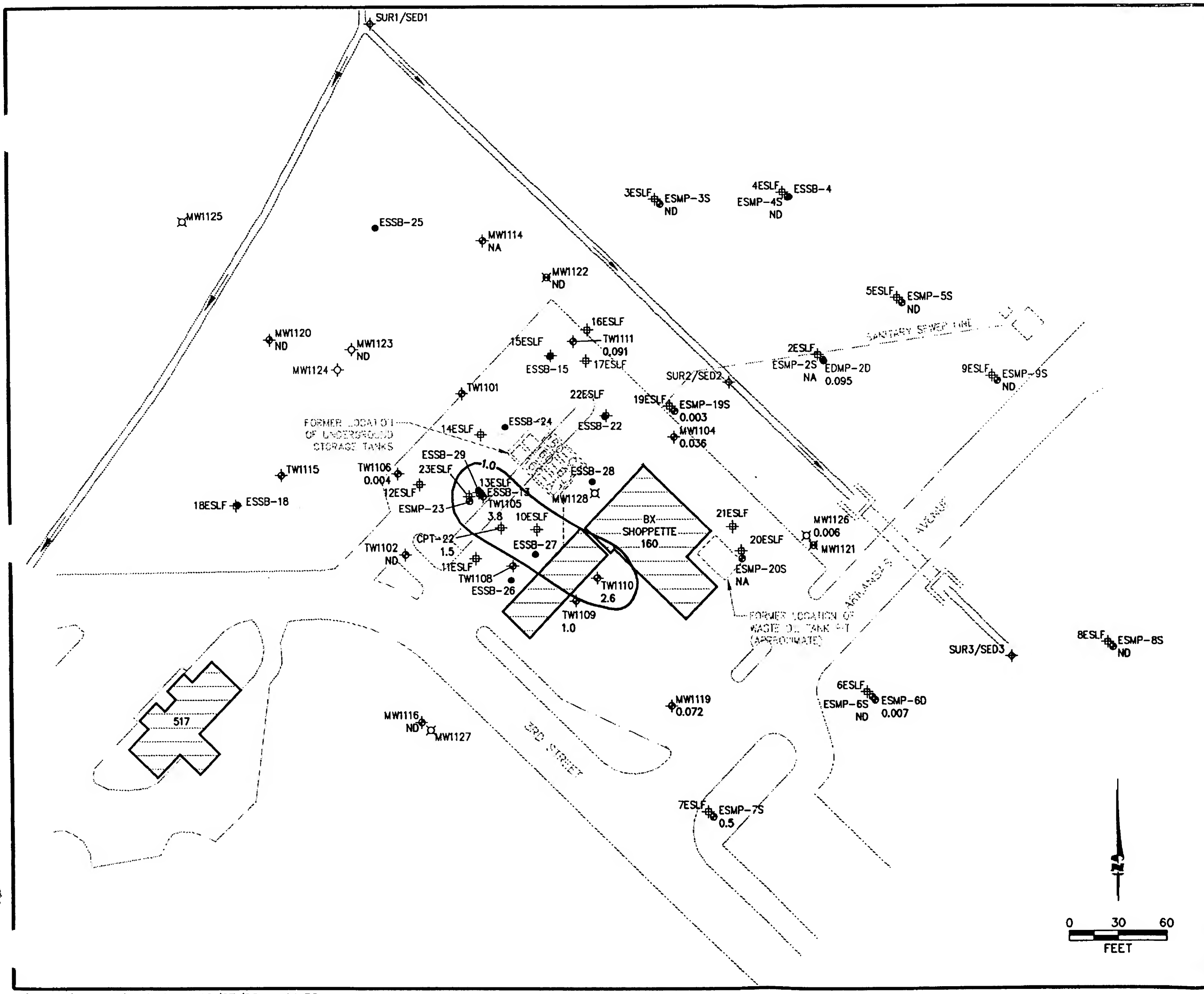

LEGEND

MW1120	MONITORING WELL, INSTALLED DECEMBER 1991–JANUARY 1992
MW1121	MONITORING WELL, INSTALLED APRIL 1995
MW1123	MONITORING WELL, INSTALLED AUGUST 1995
MW1126	MONITORING WELL, INSTALLED OCTOBER 1995–NOVEMBER 1995
ESMP-25	MONITORING POINT, INSTALLED MARCH 1996
ESSB-18	SOIL BORING, MARCH 1996
18ESLF	CONE PENETROMETER/LASER INDUCED FLUORESCENCE (CPT/LIF) LOCATION, MARCH 1996
SUR1/SED1	SURFACE WATER (SUR) OR SEDIMENT (SED) SAMPLING LOCATION, MARCH 1996
1.0	LINE OF EQUAL METHANE CONCENTRATION (mg/L)
ND	NONDETECT
NA	NOT ANALYZED

FIGURE 4.11

METHANE ISOPLETH MAP FOR SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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where the highest dissolved BTEX concentration and mobile LNAPL also were detected. Likewise, the highest methane concentration in the semi-confined aquifer was detected at ESMP-23D where the highest BTEX concentration was observed in the semi-confined aquifer. These relationships are a strong indication that methanogenesis of BTEX is occurring at the site.

The stoichiometry of BTEX oxidation to carbon dioxide and methane by methanogenesis is presented in Table 4.4. On average, approximately 1 mg of total BTEX is degraded for every 0.78 mg of methane produced. Given maximum detected methane concentrations of 3.8 mg/L in the shallow surficial aquifer and 3.0 mg/L in the deeper aquifer, and the assumption of negligible methane concentrations in background groundwater from both aquifers, methanogenesis can account for the capacity to assimilate approximately 4.9 mg/L (4,900 µg/L) and 3.8 mg/L (3,800 µg/L) of total BTEX in the surficial and semi-confined aquifers, respectively. Both assimilative capacities are conservative estimates of the BTEX attenuation through methanogenesis because these calculations are based on observed methane concentrations and not on the amount of carbon dioxide (the electron acceptor in methanogenesis) available in the aquifer. As methanogenesis produces more carbon dioxide than it consumes (Table 4.4), an unlimited supply of carbon dioxide is theoretically available once the process of methanogenesis has been initiated. Carbon dioxide levels above background concentrations were observed at the site (Table 4.5) and lend support to the possibility of increased methanogenic potential (discussed in Section 4.5.2.8 in greater detail). Therefore, methanogenesis is limited by the rate of reaction rather than the source of electron acceptors. This estimate of assimilative capacity also conservatively assumes that all of the produced methane remains in solution; however, this assumption is not realistic as the solubility limit of methane in water is approached.

4.5.2.7 Reduction/Oxidation Potential

Redox potentials were measured at groundwater monitoring wells and points in March 1996. Redox potential is a measure of the relative tendency of a solution to accept or transfer electrons. The redox potential of a groundwater system depends on which electron acceptors are being reduced by microbes during BTEX oxidation. The redox potentials at the site range from 222 millivolts (mV) to -114 mV in the aquifer, and from 13 mV to -235 mV in the underlying aquifer. Table 4.5 summarizes available redox potential data. The areal extent of redox potentials is illustrated graphically on

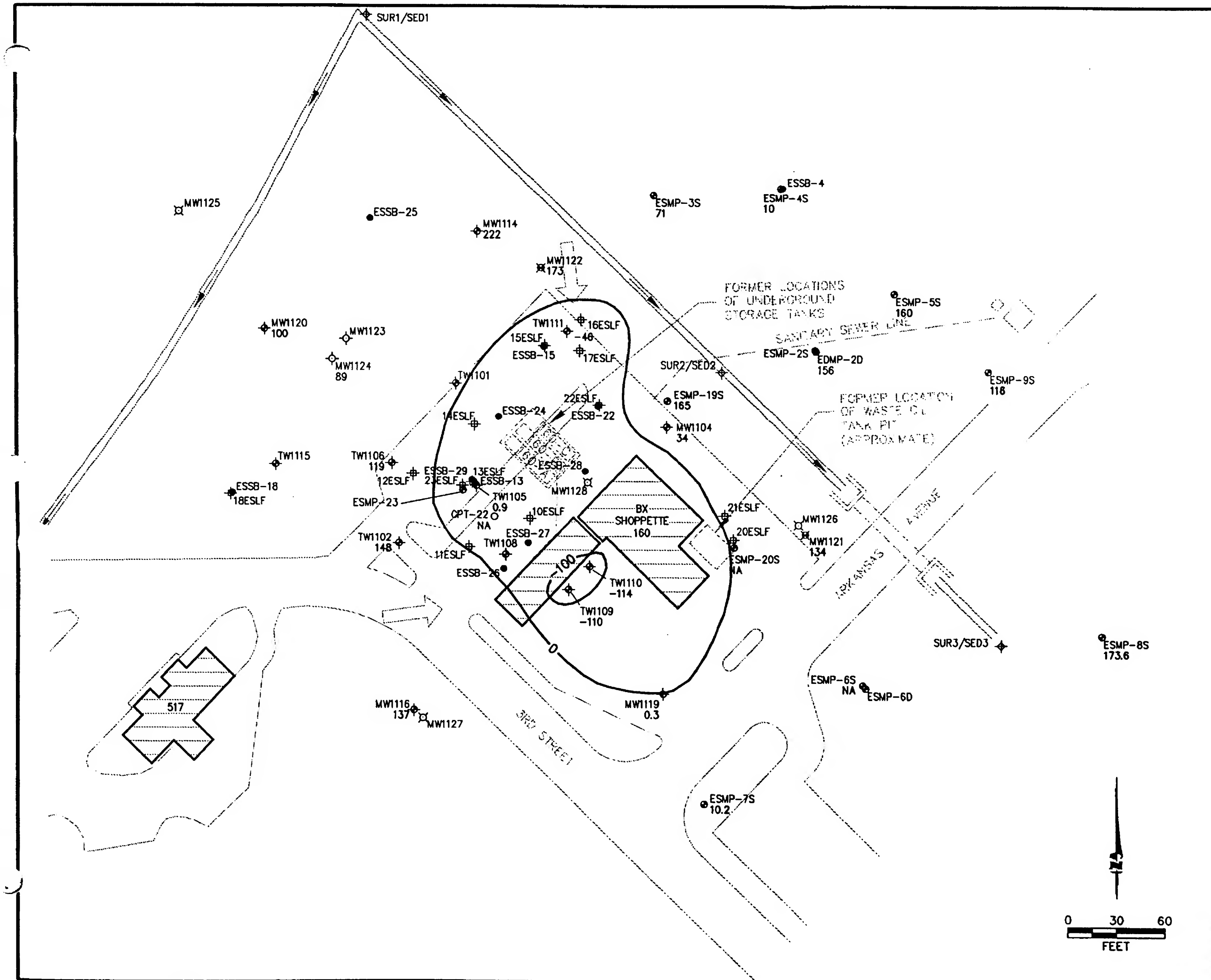
Figure 4.12. As expected, the area of low redox potentials overlap the areas of elevated BTEX contamination, decreased oxygen, elevated soluble manganese, low sulfate concentrations, elevated ferrous iron, and methane concentrations (compare Figure 4.12 with Figures 4.5, 4.7, 4.8, 4.9, 4.10, and 4.11). In particular, the area with redox potential below 0 mV roughly coincides with the area of BTEX concentrations in excess of 100 µg/L.

4.5.2.8 Alkalinity and Carbon Dioxide Evolution

Carbon dioxide is produced during the bioremediation of petroleum hydrocarbons. In aquifers that have carbonate minerals as part of the matrix, carbon dioxide forms carbonic acid, which dissolves these minerals, increasing the alkalinity of the groundwater. An increase in alkalinity (measured as $CaCO_3$) in an area with BTEX concentrations elevated above background conditions can be used to infer the amount of petroleum hydrocarbon destroyed through aerobic respiration, denitrification, manganese reduction, ferric iron reduction, and sulfate reduction. In addition, carbon dioxide produced in these aerobic and anaerobic reactions can be cycled in the methanogenic reactions to continue BTEX biodegradation through methanogenesis.

Free carbon dioxide was measured in groundwater samples collected in March 1996. These measurements are summarized in Table 4.5 and illustrated for the shallow groundwater on Figure 4.13. Carbon dioxide evolution above background concentrations is occurring as a result of combined aerobic and anaerobic biodegradation processes. A direct estimation of the aquifer assimilative capacity based on carbon dioxide evolution is not possible because of the complex carbonate/bicarbonate balance.

Total alkalinity (as $CaCO_3$) also was measured in groundwater samples collected in March 1996. These measurements are summarized in Table 4.5 and illustrated for shallow groundwater on Figure 4.14. Alkalinity is a measure of the ability of groundwater to buffer changes in pH caused by the addition of biologically generated acids. Total alkalinity at the site varied from 60 mg/L to 780 mg/L in the surface aquifer, and from 140 mg/L to 520 mg/L in the lower aquifer. This range of alkalinity is sufficient to buffer potential changes in pH caused by biologically mediated BTEX oxidation reactions. Additionally, comparison of alkalinity concentrations and elevated BTEX concentrations (Figures 4.14 and 4.5) suggest that increased carbonate



LEGEND

MW1120	MONITORING WELL, INSTALLED DECEMBER 1991–JANUARY 1992
MW1121	MONITORING WELL, INSTALLED APRIL 1995
MW1123	MONITORING WELL, INSTALLED AUGUST 1995
MW1126	MONITORING WELL, INSTALLED OCTOBER 1995–NOVEMBER 1995
ESMP-25	MONITORING POINT, INSTALLED MARCH 1996
ESSB-18	SOIL BORING, MARCH 1996
18ESLF	CONE PENETROMETER/LASER INDUCED FLUORESCENCE (CPT/LIF) LOCATION, MARCH 1996
SUR1/SED1	SURFACE WATER (SUR) OR SEDIMENT (SED) SAMPLING LOCATION, MARCH 1996
0	LINE OF EQUAL REDOX POTENTIAL (mV)
NA	NOT AVAILABLE
O	MONITORING WELL, INSTALLATION DATE UNKNOWN

FIGURE 4.12

REDOX POTENTIALS IN SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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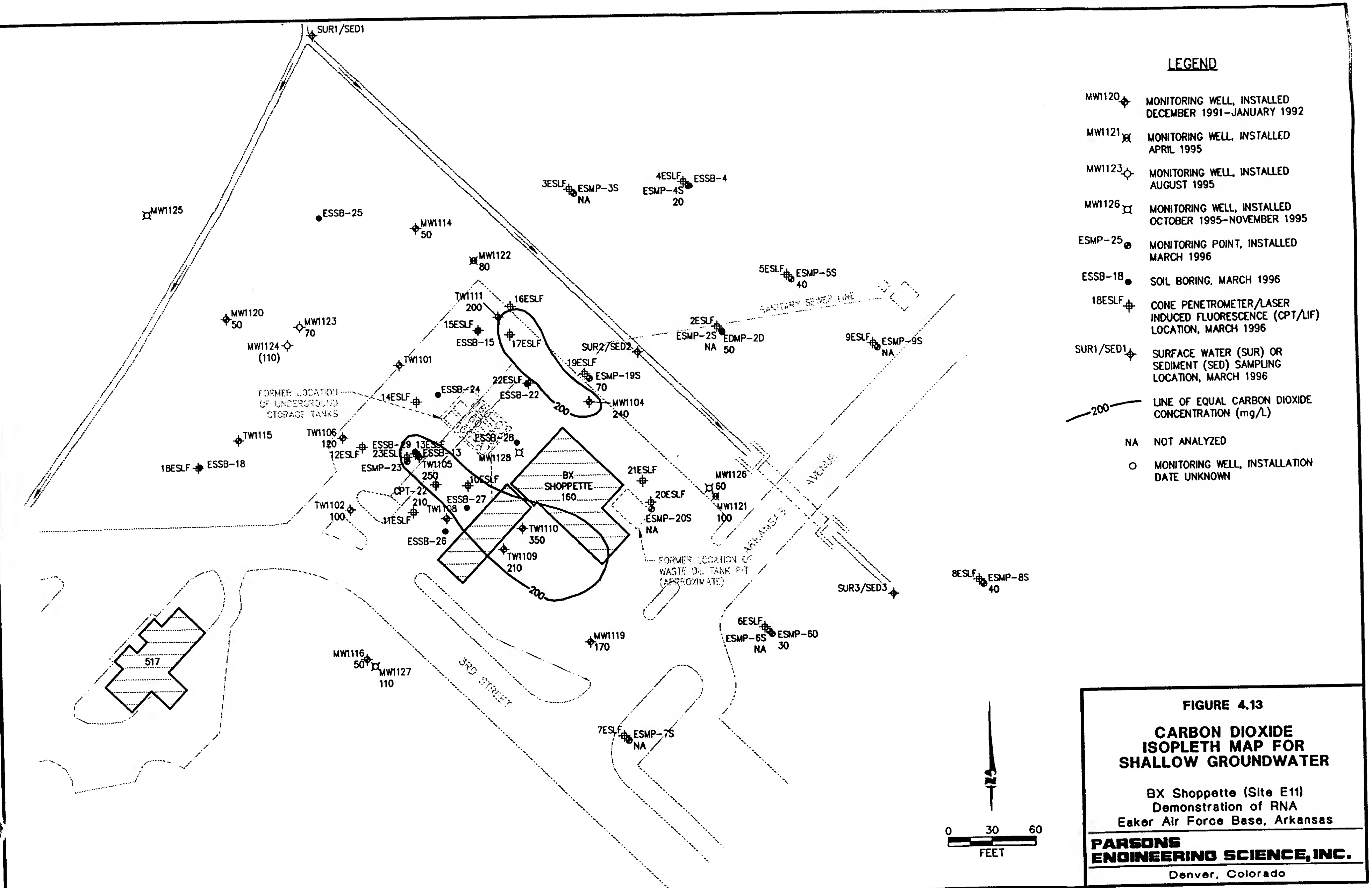

FIGURE 4.13

CARBON DIOXIDE ISOPLETH MAP FOR SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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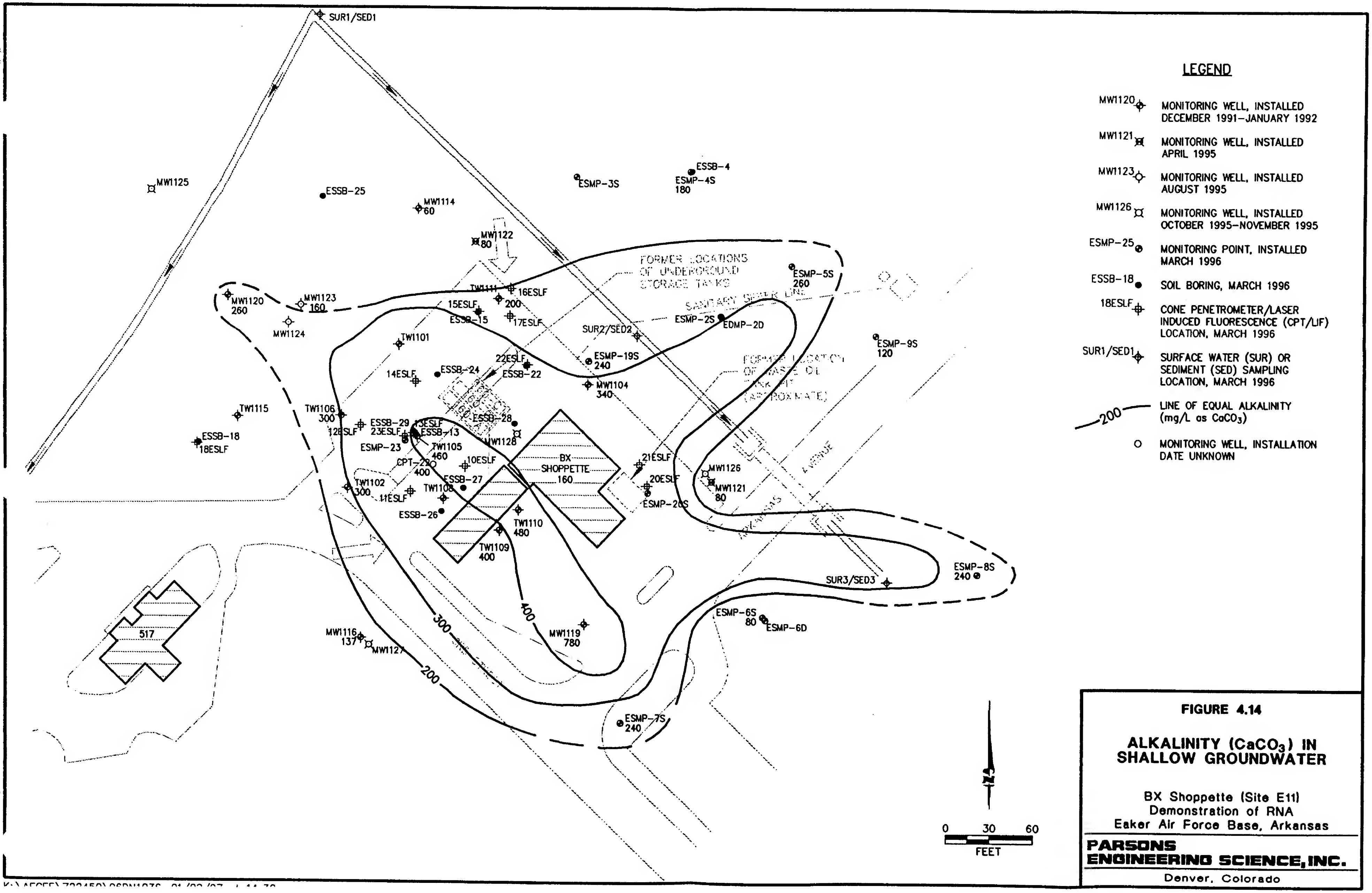

FIGURE 4.14

ALKALINITY ($CaCO_3$) IN SHALLOW GROUNDWATER

BX Shoppette (Site E11)
Demonstration of RNA
Eaker Air Force Base, Arkansas

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

concentrations could be directly related to increased carbon dioxide concentrations from the mineralization of the BTEX compounds via natural attenuation processes.

4.5.2.9 pH

pH was measured for groundwater samples collected from groundwater monitoring points and monitoring wells in March 1996. These measurements are summarized in Table 4.5. The pH of a solution is the negative logarithm of the hydrogen ion concentration $[H^+]$. Groundwater pH measured at the site ranges from 5.0 to 6.0 standard units in both the shallow surficial and semi-confined aquifers. The pH decreases resulting from biologically generated acids in the areas of most active biodegradation are buffered by site alkalinity. As groundwater pH becomes increasingly acidic, fungi may predominate over bacteria in successfully biodegrading hydrocarbons (Atlas, 1988; Brock *et al.*, 1994).

4.5.2.10 Temperature

Groundwater temperature was measured at groundwater monitoring points and monitoring wells in March 1996. Table 4.5 summarizes groundwater temperature readings. Temperature affects the types and growth rates of bacteria that can be supported in the groundwater environment, with higher temperatures generally resulting in higher growth rates. Temperatures in the shallow surficial aquifer varied from 10.3°C to 17.5°C, with an average of 13.5°C. Temperatures in the lower aquifer varied from 12.9°C to 17.5°C, with an average of 15.4°C. These temperatures are within an optimal range for psychrophilic, hydrocarbon-degrading microorganisms to survive.

4.5.3 Discussion

Numerous laboratory and field studies have shown that hydrocarbon-degrading bacteria can participate in the degradation of many of the chemical components of jet fuel and gasoline, including the BTEX compounds (e.g., Jamison *et al.,* 1975; Atlas, 1981, 1984, and 1988; Gibson and Subramanian, 1984; Reinhard *et al.,* 1984; Young, 1984; Bartha, 1986; Wilson *et al.,* 1986, 1987, and 1990; Barker *et al.,* 1987; Baedecker *et al.,* 1988; Lee, 1988; Chiang *et al.,* 1989; Grbic-Galic, 1989 and 1990; Cozzarelli *et al.,* 1990; Leahy and Colewell, 1990; Altenschmidt and Fuchs, 1991; Alvarez and Vogel, 1991; Baedecker and Cozzarelli, 1991; Ball *et al.,* 1991; Bauman, 1991; Borden, 1991; Brown *et al.*, 1991; Edwards *et al.,* 1991 and 1992; Evans *et al.,* 1991a and 1991b; Haag

et al., 1991; Hutchins and Wilson, 1991; Hutchins *et al.*, 1991a and 1991b; Beller *et al.*, 1992; Bouwer, 1992; Edwards and Grbic-Galic, 1992; Thierrin *et al.*, 1992; Malone *et al.*, 1993; Davis *et al.*, 1994). Biodegradation of fuel hydrocarbons can occur when an indigenous population of hydrocarbon-degrading microorganisms is present in the aquifer and sufficient concentrations of electron acceptors, nutrients, and electron donors such as fuel hydrocarbons, are available to these organisms.

Comparison of BTEX, electron acceptor, and biodegradation byproduct isopleth maps provides strong qualitative evidence for biodegradation of BTEX compounds. Isopleth maps suggest that five electron receptors are particularly active in the biodegradation of BTEX compounds at the BX Shoppette: oxygen, manganese (indicated by the presence of soluble manganese), ferric iron (indicated by the presence of ferrous iron), sulfate, and carbon dioxide (indicated by the presence of methane). Typically, zones of depleted oxygen, elevated soluble manganese, elevated methane concentration, depleted sulfate concentration, and elevated ferrous iron concentration coincide with elevated dissolved BTEX concentrations; however, the spatial distributions of electron acceptors and metabolic byproducts vary somewhat. This variation likely results from the preference of the fuel-degrading microbes for a specific range of groundwater conditions. Conditions present at any given location may either stimulate or inhibit the various microbes. As noted above, variations in both alkalinity and pH may affect the activity levels of indigenous microbes, although these parameters were shown to be at adequate levels at the site.

4.5.4 Expressed Assimilative Capacity

The data presented in the preceding sections suggest that mineralization of BTEX compounds is occurring through the microbially mediated processes of aerobic biodegradation, manganese reduction, iron reduction, sulfate reduction, and methanogenesis. On the basis of the stoichiometry presented in Table 4.4 and observed background electron acceptors, the expressed BTEX assimilative capacity of shallow groundwater and deep groundwater, respectively, at the BX Shoppette are at least 16,720 µg/L and 19,320 µg/L (Table 4.6).

A closed system with 2 liters of water can be used to help visualize the physical meaning of assimilative capacity. Assume that the first liter contains no fuel hydrocarbons, but it contains fuel degrading microorganisms and has an assimilative

TABLE 4.6
EXPRESSED ASSIMILATIVE CAPACITY OF SITE GROUNDWATER
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Electron Acceptor or Process	Expressed BTEX Assimilative Capacity (µg/L)-Shallow	Expressed BTEX Assimilative Capacity (µg/L)-Deep
Dissolved Oxygen	1,860	670
Nitrate	0	0
Manganese Reduction	960	250
Iron Reduction	1,550	900
Sulfate	7,450	13,700
Methanogenesis	4,900	3,800
Expressed Assimilative Capacity	16,720	19,320

capacity of exactly "*x*"µg of fuel hydrocarbons. The second liter has no assimilative capacity; however, it contains fuel hydrocarbons. As long as these 2 liters of water are kept separate, biodegradation of the fuel hydrocarbons will not occur. If these 2 liters are combined in a closed system, biodegradation will commence and continue until the fuel hydrocarbons are depleted, the electron acceptors are depleted, or the environment becomes acutely toxic to the fuel degrading microorganisms. Assuming a nonlethal environment, if fewer than "*x*" µg of fuel hydrocarbons were in the second liter, all of the fuel hydrocarbons will eventually degrade given a sufficient time; likewise, if greater than "x" µg of fuel hydrocarbons were in the second liter of water, only "*x*" µg of fuel hydrocarbons would ultimately degrade.

The groundwater beneath the BX Shoppette is an open system, which continually receives additional electron receptors from upgradient and the percolation of precipitation. This means that the assimilative capacity is not a fixed entity as it is in a closed system, and therefore cannot be compared directly to contaminant concentrations in the groundwater. Rather, the expressed assimilative capacity of groundwater is intended to serve as a qualitative tool. Although the expressed assimilative capacities for the shallow groundwater is lower than the highest measured total BTEX concentration (84,900 µg/L, TW-1105), and that of the lower aquifer is greater than the highest BTEX

concentration (12,150 μg/L, ESMP-23D), the fate of BTEX in groundwater and the potential impact to receptors is dependent on the relationship between the kinetics of biodegradation and the solute transport velocity (Chappelle, 1994). These significant expressed assimilative capacities are a strong indicator that biodegradation is occurring; however, it is not an indication that biodegradation will proceed to completion before potential downgradient receptors are impacted.

Although geochemical indicators cannot be used to predict the rate of BTEX biodegradation, it is important to observe that BTEX concentrations decrease with increasing distance from the source area. Along the centerline of the BTEX plume (TW-1109) the fraction of benzene in total BTEX compared to the fraction of xylenes in BTEX (71 percent versus 21 percent, respectively) is relatively high, whereas the same fractions near the source areas (TW-1111 and TW-1105) were lower (27 percent for benzene vs. 17 percent for xylenes). This trend supports literature that suggests that benzene is the BTEX compound most recalcitrant to biodegradation in the presence of other biodegradable substrates (Edwards *et al.,* 1992a and 1992b) and most free in groundwater, and should therefore comprise an increasingly higher percentage of the BTEX in groundwater samples collected increasingly downgradient of the source area. However, benzene concentrations rapidly decreases near the plume periphery (near ESMP-6S) and suggests that benzene biodegradation increases as other available hydrocarbons (i.e., toluene and xylenes) are decreased in concentration through biodegradation. The apparent susceptibility of benzene to rapid biodegradation near the periphery of the BTEX plume, combined with other natural attenuation mechanisms, is causing greater than 99.99 percent removal of benzene concentrations between TW-1105 and ESMP-6S.

At the BX Shoppette, natural attenuation mechanisms are removing significant concentrations of BTEX contamination before discharge to the drainage canal. Although BTEX may discharge to the drainage canal at low concentrations, no BTEX contamination was detected from surface water samples collected from the drainage canal at locations where the areal extent of the observed BTEX plume overlapped the drainage canal (Figure 4.5). Despite the presence of a continuing source of leachable BTEX contamination [up to 1,200 gallons of mobile LNAPL were detected in March 1996 (Section 4.2)], natural attenuation processes have effectively attenuated BT..X contamination at the site to within 300 feet of the source area. Furthermore, a bioslurper

installed at the site in September 1996 has begun removing mobile LNAPL, and at least 250 gallons of free-product have been recovered. Therefore, the ability of the aquifer to attenuate BTEX contamination within several hundred feet of the source area and the reduction of mobile LNAPL through bioslurping suggests that RNA should be given serious consideration as a remedial solution, other as a single remedy or in concert with other technologies, as necessary.

SECTION 5

GROUNDWATER MODELING

5.1 GENERAL OVERVIEW

In order to assist with remediation decision making at the BX Shoppette, Parsons ES modeled the fate and transport of the dissolved BTEX plume. The modeling effort has three primary objectives: 1) to predict the future extent and concentration of the dissolved contaminant plume by modeling the combined effects of advection, dispersion, sorption, and biodegradation; 2) to assess the potential for exposure of downgradient receptors to contaminant concentrations that exceed regulatory limits intended to be protective of human health and the environment; and 3) to provide technical support for RNA, as appropriate, at post-modeling regulatory negotiations. The model was developed using site-specific data and conservative assumptions about governing physical and chemical processes. Because of the conservative nature of model input, the reduction in contaminant mass caused by natural attenuation is expected to exceed model predictions. This analysis is not intended to represent a baseline assessment of potential risks posed by site contamination.

The Bioscreen model (v. 1.2), developed by AFCEE, was used to estimate the potential for dissolved BTEX migration and degradation by naturally occurring mechanisms operating at the BX Shoppette. Bioscreen incorporates advection, dispersion, sorption, and biodegradation to simulate a one-dimensional (with two-dimensional characteristics) contaminant plume migration and degradation. The Bioscreen 1.2 model is programmed in a Microsoft® Excel spreadsheet environment and based on the Domenico (1987) analytical solute transport model. Bioscreen can simulate instantaneous reactions (using available geochemical data) or first-order rate constants in order to simulate biodegradation. The selection of instantaneous reactions or first-order biodegradation rates is dependent on site conditions, including: availability of geochemical indicator data, groundwater velocity, residence time, and sorption potential. Bioscreen can simulate the effects of a decreasing source term (e.g., mobile or residual LNAPL) with a first-order decay process.

In recent years it has become apparent that anaerobic processes such as denitrification, iron reduction, sulfate reduction, and methanogenesis can be important BTEX degradation mechanisms (Grbic′-Galic′, 1990; Beller *et al.*, 1992; Edwards *et al.*, 1992; Edwards and Grbic′-Galic′, 1992; Grbic′-Galic′ and Vogel, 1987; Lovley *et al.*, 1989; Hutchins, 1991). Because geochemical evidence supports the occurrence of anaerobic biodegradation processes at the BX Shoppette (Section 4), the combined processes of aerobic and anaerobic biodegradation were considered in modeling BTEX fate and transport at the site. The following subsections discuss in detail the input parameters, the model assumptions, the model calibration, and the simulation results.

5.2 CONCEPTUAL MODEL DESIGN AND ASSUMPTIONS

Prior to developing a groundwater flow and/or contaminant transport model, it is important to determine if sufficient data are available to provide a reasonable estimate of aquifer conditions. In addition, it is important to ensure that any limiting assumptions can be justified. Data and information presented in Sections 3 and 4 suggest that manganese dioxide, ferric hydroxide, sulfate, and carbon dioxide are the principal electron acceptors for anaerobic biodegradation at the site. Moderate background concentrations of DO also suggest that aerobic biodegradation will significantly contribute to the biodegradation of BTEX compounds.

On the basis of the data presented in Section 3, the shallow saturated zone was conceptualized as an unconfined shallow aquifer composed of heterogeneous sands, silty sand, silty clay, and clay (Figure 3.1 to 3.3). The heterogeneous fine-grained nature of the surficial aquifer geology prevents groundwater contamination from quickly migrating toward potential downgradient receptors. Conductive intervals of sand and silty sand are present, but these intervals are present as discontinuous soil lenses that terminate in low-permeability clay or silty clay units. Groundwater elevation and flow direction in the surficial aquifer are influenced by this heterogeneous site geology, local drainage canals, flood control measures, surface paving, and seasonal precipitation.

A review of historic and current groundwater elevation measurements suggest that groundwater flow direction in the surficial aquifer can vary between east/southeast and west/northwest. Furthermore, a depression in the groundwater table beneath the BX shoppette consistently has been observed during all groundwater sampling events. Surface paving over the site, season, and adjacent drainage canals are suspected of

contributing to the observed depression in the groundwater table. The groundwater depression may also be the result of clay or silty clay intervals that rise above the groundwater table and cause localized barriers to groundwater flow or "perched" groundwater conditions, thereby creating a "bathtub" effect. Despite the complex site stratigraphy, the predominant groundwater flow direction appears to be to the east/southeast. This observation is supported by total BTEX concentrations in shallow groundwater extending to the east/southeast of the source areas (Figure 4.5). BTEX concentrations were not detected west of the source area, suggesting that alternating groundwater flow directions are not causing solute transport in this direction, although historic groundwater elevation measurements suggest that this may be possible. Two discrete source areas are contributing to groundwater contamination and are located near TW-1105 and TW-1111.

A semi-confined sandy aquifer is separated from the surficial aquifer by a clay layer of varying thickness. BTEX concentrations detected in the lower sandy aquifer indicate impact on this unit. However, the magnitude of impact to the lower aquifer may be low; the highest detected BTEX concentration in this unit was 81.9 μg/L at MW-1124 in August 1995. Furthermore, BTEX concentrations at this location were below analytical detection limits in March 1996. Potential BTEX contamination reaching the lower aquifer will migrate to the southwest at a very low seepage velocity that is governed by a relatively flat potentiometric surface gradient [approximately 0.00026 ft/ft (Section 3.3.2.1)].

The use of a simple one-dimensional analytical model to simulate the groundwater flow conditions at the site is more appropriate than using a more complex model. Typically, complex site conditions warrant the use of sophisticated models (two- to three-dimensional) to accurately predict contaminant transport characteristics; however, a two-dimensional numerical model, such as Bioplume II, requires a significant amount of hydrogeologic data and calibration time to accurately simulate contaminant migration characteristics for a single set of hydraulic conditions and cannot simulate contaminant migration in an aquifer that has potentially alternating groundwater flow directions without using multiple groundwater model calibrations to simulate each possible groundwater flow pattern. Although the current BTEX plume appears to migrate to the east/southeast, and suggests that the dominant groundwater flow direction is similar, the potential for fluctuating groundwater flow directions suggests that migration could occur to the west. Because of the uncertainty introduced by these complexities, a simpler semi-

analytical model used in conjunction with conservative assumptions about site conditions is as useful as a numerical model for making reasonable and conservative model predictions about groundwater flow in multiple directions. Conservatism in model predictions will ensure that a "worst-case" scenario is simulated to help offset any uncertainties about irregular site conditions that cannot be simulated with a simple one-dimensional model, such as Bioscreen.

As described in the following sections, several conservative assumptions were used to reduce the site conditions into a one-dimensional conceptual site model capable of predicting contaminant migration. The data used or the assumptions made in modeling are outlined in the following sections. The contaminated soils at the site are undergoing remediation through bioslurping. As a result, they are unlikely to serve as a long-term continuing source of dissolved BTEX contamination at the site.

5.3 INITIAL MODEL SETUP

Where possible, the initial setup for the models was based on site data. Where site data were ambiguous (e.g., for groundwater gradient), conservative assumptions were made so that model predictions reflect worst-case conditions (e.g., maximum groundwater gradient). Where site-specific data were not available (e.g., for effective porosity), reasonable assumptions were made on the basis of widely accepted literature values. The following sections describe the basic model setup for groundwater modeling of the surficial and semi-confined aquifers. The analytical model parameters that were varied during model calibration are discussed in Section 5.4.

5.3.1 Hydraulic Conductivity and Groundwater Gradient

The Bioscreen model assumes a uniform hydraulic conductivity in model calculations. Hydraulic conductivity describes the ability of an aquifer to transmit groundwater through a unit area of aquifer. Table 3.2 lists the measured hydraulic conductivities of five shallow and four deep monitoring well locations. Hydraulic conductivities based on rising-head slug tests of wells located in the surficial aquifer and around the source area ranged from 0.62 ft/day to 5.89 ft/day (monitoring wells MW-1116, MW-1119, and MW-1123). To be conservative, a hydraulic conductivity of 5.89 ft/day was selected for the surficial aquifer model. The higher hydraulic conductivity permits the fastest migration

potential for contamination away from the source area. The measured hydraulic conductivities based on rising-head slug tests for the deeper, sandy aquifer ranged from 2.86 to 3.44 ft/day (MW-1124 to MW-1127). To be conservative, the highest hydraulic conductivity of 3.44 ft/day also was selected for the sand aquifer to permit the fastest potential migration of contamination away from the source area.

The water table elevation map presented on Figure 3.5 was used to determine a hydraulic gradient for the surficial aquifer. Horizontal gradients based on Figure 3.5 (March 1996) ranged from approximately 0.0016 ft/ft (area of former USTs) to 0.067 ft/ft (south, east, and north of the source area). These hydraulic gradients were estimated from observed groundwater elevations, which may include locally perched conditions and do not necessarily reflect groundwater gradients in and immediately adjacent to the source area. Therefore, three possible flow paths were evaluated to estimate a representative gradient for the source area. All three flow paths correspond to observed groundwater flow directions over the recorded history of the site, and include: TW-1106, TW-1105, and TW-1110; MW-1120, TW-1105, and TW-1109; MW-1120, TW-1105, TW-1109, and MW-1119. Plots of groundwater elevations along these flowpaths are included in Appendix D. Along this generally northwest/southeast corridor, gradients ranged from 0.00061 ft/ft to the southeast to 0.0088 ft/ft to the northwest. To be conservative, the groundwater gradient at the high end of this range (0.0088 ft/ft) was assumed to represent groundwater flow conditions at the site. Although historic groundwater elevation data suggest steeper groundwater gradients at different locations and times at the site, the selected gradient of 0.0088 ft/ft is based on groundwater elevations in the vicinity of highest groundwater contamination. Furthermore, the March 1996 sampling event had more groundwater elevation measurement points of any recorded sampling event. Therefore, it was assumed for simplicity that the March 1996 water levels and gradient were most representative of site conditions. Assuming a groundwater gradient of 0.0088 ft/ft, a hydraulic conductivity of 5.89 ft/day (0.0021 cm/s), and a porosity of 0.25, the estimated groundwater velocity used in model calibration was 0.212 ft/day (77.4 ft/year).

Groundwater gradients in the deeper sand aquifer were estimated from March 1996 data. A southwesterly gradient of 0.00026 ft/ft (Section 3.4.2.1) was observed and was used in model calibration for the deeper aquifer. Assuming a groundwater gradient of 0.00026, a hydraulic conductivity of 3.44 ft/day (0.0012 cm/s), and a porosity of 0.25, the estimated groundwater velocity used in model calibration for the deep aquifer was 0.0036 ft/day (1.3 ft/year).

5.3.2 Dispersivity

Mechanical dispersion is a physical process that causes groundwater to travel faster or slower than the average linear groundwater velocity observed at a site. Mechanical dispersion results from heterogeneities in the aquifer that include differences in pore size, path length, and pore friction within the soil matrix, as well as differing flow paths resulting from geologic heterogeneity. Dispersivity is a coefficient used to describe the degree of mechanical dispersion occurring within an aquifer. The degree of mechanical dispersion is empirically expressed as the product of dispersivity and average linear groundwater velocity.

The selection of dispersivity values is usually very difficult because of the impracticality of performing dispersivity tests *in situ*. However, a commonly used relationship for dispersivity estimation is one-tenth of the groundwater plume length (Pickens and Grisak, 1981). This relationship was used to estimate the longitudinal dispersivity of the site at approximately 33 feet for the shallow aquifer (assuming an observed plume length of 330 feet). 0.1X

Using a ratio of estimated GW velocities, the dispersivity for the deep aquifer was assumed to be 0.6 feet [33 ft x (1.3 ft/year ÷17.4 ft/yr)]. Lower dispersivity value increase the conservatism of model estimates because the potential for contaminant dilution is decreased.

5.3.3 Coefficient of Retardation

Retardation of the BTEX compounds relative to the advective velocity of the groundwater occurs when BTEX molecules are sorbed to the aquifer matrix. The coefficients of retardation for the BTEX compounds were estimated from measured TOC concentrations in the soils in and near the saturated zone at the site, an assumed bulk density of 1.65 grams per cubic centimeter (g/cc) (Freeze and Cherry, 1979), an assumed soil sorption coefficient (K_{oc}) for benzene of 79 L/kg (as listed by Wiedemeier *et al.* (1995), and a fraction of organic carbon (f_{oc}) of 0.07 percent (Section 4.3.2). The retardation coefficient of 1.36 for benzene was used to represent the sorptive potential for all the BTEX compounds because it was the least sorptive BTEX compound and adds conservatism to the model. Appendix D includes retardation coefficient calculations for the BTEX compounds. TOC data are not available for soils in the sand aquifer; therefore,

it was assumed that sorption in the deeper aquifer would be equivalent to that of the surficial aquifer.

5.3.4 BTEX Concentrations

The BTEX concentrations from March 1996 were used in the model to project future downgradient concentrations. Table 4.3 presents dissolved BTEX concentration data. Figure 4.5 shows the areal distribution of dissolved groundwater BTEX in March 1996 and depicts two potential source areas. The shape and distribution of the total BTEX plume are the result of advective-dispersive transport and biodegradation of dissolved BTEX contamination originating from both source areas at the BX Shoppette. The area nearest to the BX Shoppette (source near TW-1105) was identified as the primary site source because it has the highest BTEX concentrations (84,900 μg/L at TW-1105 in March 1996) and measurable mobile LNAPL; therefore, it has higher potential for impact to downgradient receptors. It is assumed that relative changes in the southern lobe of the BTEX plume will be representative of changes in the northern lobe of the BTEX plume.

The greatest BTEX concentration detected in the semi-confined aquifer was 81.9 μg/L in August 1995 at monitoring well MW-1124. BTEX compounds also have been detected in monitoring wells MW-1125, MW-1127, and MW-1128 at concentrations ranging from 1 to 50 μg/L. Low concentrations of BTEX compounds in monitoring wells MW-1124, MW-1127, and MW-1118 suggest that BTEX in the source area near TW-1105 may be contaminating the lower semi-confined aquifer. Therefore, higher concentrations of BTEX (>81.9 μg/L) may exist below the source area in the semi-confined aquifer. A BTEX concentration of 1,000 μg/L in the lower aquifer was assumed to exist as a conservative estimate in the model calibration.

5.3.5 Degradation Rates

Available data strongly suggest that aerobic and anaerobic degradation is occurring at the site. Combined anaerobic processes account for 89 percent of the assimilative capacity of shallow site groundwater (Table 4.6). As with a large number of biological processes, biodegradation can generally be described using a first-order rate constant and the equation:

$$\frac{C}{C_0} = e^{-kt}$$

Where: C = Contaminant Concentration at Time t
C_0 = Initial Contaminant Concentration
k = Coefficient of Anaerobic Decay (anaerobic rate constant)
t = time

Two methods of calculating rate constants are currently available to quantify rates of biodegradation at the field scale and area applicable for use with available site data. The first method involves the use of a biologically recalcitrant compound found in the dissolved BTEX plume that can be used as a conservative tracer. The second method, proposed by Buscheck and Alcantar (1995) involves interpretation of a steady-state contaminant plume configuration and is based on the one-dimensional steady-state analytical solution to the advection-dispersion equation presented by Bear (1979).

5.3.5.1 Tracer Method

A convenient way of estimating biodegradation rate constants is to use compounds present in the dissolved contaminant plume that that are biologically recalcitrant. One such compound that was detected at the site was trimethylbenzene (TMB). The three isomers of this compound (*1,2,3*-TMB, *1,2,4*-TMB, and *1,3,5*-TMB) are generally present in sufficient quantities in fuel mixtures to be readily detectable when dissolved in groundwater. A similar tracer detected at the BX Shoppette was 1,2,3,4-tetramethylbenzene (1,2,3,4-TEMB), which is considered more recalcitrant to biodegradation than the TMBs. Overall, the TMB and TEMB compounds are fairly recalcitrant to biodegradation under anaerobic conditions; however, the compounds do not make good tracers under aerobic conditions (because they are readily biodegraded in aerobic environments). Therefore, the most appropriate use of TMB or TEMB tracers in estimating biodegradation rates is with groundwater plumes that have depleted DO concentrations at points along the groundwater flow path.

In addition to biological recalcitrance, an ideal tracer would have Henry's Law and soil sorption coefficients identical to the contaminant of interest; however, TMB and TEMB are more hydrophobic than BTEX, resulting in a higher soil sorption coefficients. This causes preferential sorption of the tracer compounds, and an increase in the

coefficients of retardation for dissolved TMB or TEMB in the aquifer. Therefore, the tracer can migrate at a velocity that is significantly slower than the compound of interest. Under this condition, it is more important to evaluate contaminant and tracer concentrations after equal travel times. The equal time assumption ensures that both the contaminant and tracer are more equally affected by dilution/dispersion and sorption, which are the two dominant non-destructive attenuation mechanisms in most systems. The ratio of tracer velocity to contaminant velocity can be used to switch from equal travel distances to equal travel times as follows:

$$\frac{V_t}{V_c} = \left(\frac{V_{gw}}{R_t}\right) / \left(\frac{V_{gw}}{R_c}\right) = \frac{R_c}{R_t}$$

Where: V_t=Velocity of tracer
V_c=Velocity of contaminant
V_{gw}=Velocity of groundwater
R_t=Coefficient of retardation for the tracer
R_c=Coefficient of retardation for the contaminant

The fraction of tracer lost over the time required for the contaminant to travel between points i-1 and i is represented by the expression $R_c/R_t(1-T_i/T_{i-1})$ which is the product of the fraction of tracer lost between travel points and the ratio of retardation factors. Therefore, the fraction of tracer remaining is $1-R_c/R_t(1-T_i/T_{i-1})$. The fraction of contaminant remaining after biodegradation is equivalent to the fraction of contaminant remaining as a result of all attenuation processes divided by the fraction of tracer remaining as a result of only non-destructive attenuation processes. Therefore, the corrected concentration at point i can be represented by the following equation:

$$C_{i,corr} = C_{i-1,corr}\left(\frac{C_i}{C_{i-1}}\right)\left(\frac{1}{\left(1-\frac{R_c}{R_t}\left(1-\frac{T_i}{T_{i-1}}\right)\right)}\right)$$

where: $C_{i,corr}$= corrected contaminant concentration at point i
$C_{i-1,corr}$= corrected contaminant concentration at point i-1.
(If point i-1 is the first or most upgradient point,

$C_{i-1,corr}$ is equivalent to the observed contaminant concentration.)

C_i=observed contaminant concentration at point i

C_{i-1}=observed contaminant concentration at point i-1

T_i=observed tracer concentration at point i

T_{i-1}=observed tracer concentration at point i-1

Note: This assumes that $R_t/R_c + T_i/T_{i-1} > 1$.

If more than three points along the groundwater flow path are available, a log-linear plot of the corrected contaminant concentrations along a flow path versus the travel time from the origin can be used to determine whether the data set can be described using a first-order exponential equation (i.e. r^2 is greater than approximately 0.9). When this occurs, the exponential slope can be used as the rate constant. Once again, if aerobic conditions exist along the selected flow path, the rate constant calculation will be conservative because TEMB or TMB is not recalcitrant under aerobic conditions.

Of the detected TEMB and TMB compounds in the surficial aquifer, only 1,2,4-TMB and 1,2,3,4-TEMB were detected at three groundwater monitoring wells along the BTEX plume centerline (wells TW-1105, CPT-22, and TW-1110). As previously mentioned, at least three monitoring wells in the direction of groundwater flow are needed to construct a log-linear plot of the corrected contaminant concentrations versus time and estimate a meaningful correlation coefficient. 1,2,3,4-TEMB was selected as the tracer because of its greater recalcitrance to biodegradation.

An average rate constant for BTEX decay at the BX Shoppette was determined from March 1996 BTEX and 1,2,3,4-TEMB data. The selected flow path from TW-1105, CPT-22, and TW-1110 is anaerobic. Appendix D includes a table that presents the data for a first-order rate constant calculation for BTEX using 1,2,3,4-TEMB as a conservative tracer. The TEMB-corrected total BTEX concentration represents the theoretical BTEX concentration at a point if biodegradation were the only process affecting BTEX concentrations. The graph that accompanies the table illustrates that a rate constant of 0.0035 day^{-1} is predicted. Downgradient of TW-1110, the biodegradation rate constant would be expected to increase because the aquifer becomes aerobic. Typically, aerobic degradation rates exceed anaerobic degradation rates (Borden and Bedient, 1986). 1,2,3,4-TEMB concentrations in the semi-confined aquifer were below detection limits, and a first-order biodegradation rate normalized to TEMB was not calculated.

5.3.5.2 Method of Buscheck and Alcantar

Buscheck and Alcantar (1995) derive a relationship that allows calculation of first-order decay rate constants for steady-state plumes. This method involves coupling the regression of contaminant concentration (plotted on a logarithmic scale) versus distance downgradient (plotted on a linear scale) to an analytical solution for one-dimensional, steady-state, contaminant transport that includes advection, dispersion, sorption, and biodegradation. For a steady-state plume, the first-order decay rate is given by (Buscheck and Alcantar, 1995):

$$\lambda = \frac{v_c}{4\alpha_x}\left(\left[1 + 2\alpha_x\left(\frac{k}{v_x}\right)\right]^2 - 1\right)$$

Where: λ = first-order decay rate

v_c = retarded contaminant velocity in the x-direction

α_x = dispersivity

k/v_x = slope of line determined from a log-linear plot of contaminant concentration versus distance downgradient along flow path

The first-order decay rate includes biodegradation resulting from both aerobic and anaerobic processes; however, in the absence of oxygen, the first-order rate is equivalent to the anaerobic decay rate. Appendix D presents a table of the first-order rate constant calculation for BTEX using May 1995 data at the BX Shoppette and the method proposed by Buscheck and Alcantar (1995). An exponential fit to the data estimates a log-linear slope of 0.023 ft^{-1}. This value translates to a decay constant of 0.0062 day^{-1}. The absence of BTEX data along a potential flow path in the semi-confined aquifer prevented the estimation of a biodegradation rate by the Buscheck and Alcantar method.

5.3.5.3 Selection of a Decay Rate Constant

A review of recent literature indicates that higher rate constants generally have been calculated in anaerobic plumes at other sites. For example, Chapelle (1994) reported that at two different sites with anaerobic groundwater conditions the rate constants were both approximately 0.01 day^{-1}. Wilson *et al.* (1994), report first-order anaerobic biodegradation rates of 0.05 to 1.3 $week^{-1}$ (0.007 to 0.185 day^{-1}); Buscheck *et al.* (1993) reports first-order attenuation rates in a range of 0.001 to 0.01 day^{-1}; and Stauffer *et al.*

(1994) report rate constants of 0.01 and 0.018 day^{-1} for benzene and *p*-xylene, respectively. A first-order rate constant of 0.0062 day^{-1} was used for the calibrated analytical model. Although this rate constant is the higher of the two estimated rate constants, it provides the better calibration between simulated and observed BTEX concentrations along the plume centerline (Section 5.4.1) and falls within the low range of literature values. Further discussion of the selection of a calibrated biodegradation rate is presented in Section 5.4.

The biodegradation rate for the deeper sand aquifer was conservatively estimated at a rate of 0.0001 day^{-1}, which also is low with respect to literature values. This rate was chosen as a "worst case" biodegradation scenario for the deeper aquifer, where the greatest potential exists for contamination to reach downgradient potable water wells. The anaerobic biodegradation potential of the semi-confined aquifer exceeds that of the surficial aquifer on the basis of assimilative capacity. Therefore, the biodegradation rate may in reality equal or exceed that of the shallow aquifer.

5.4 ANALYTICAL MODEL RESULTS

Bioscreen is based on the Domenico (1987) analytical model which is designed for one dimensional transport of a decaying contaminant species. The one dimensional ability of Bioscreen is defined as a two-dimensional model grid with a variable domain of 1 to 5 cells (x-dimension) and a constant range of 10 cells (y-dimension). The depth of these cells is maintained at a constant value over the model grid. The Bioscreen model has the ability to simulate advection, dispersion, adsorption, aerobic decay, and anaerobic decay. Bioscreen assumes a homogeneous, isotropic aquifer; a uniform, constant-velocity flow field in the x-direction only; a constant longitudinal hydrodynamic dispersion; a source that fully penetrates the aquifer; a first-order or instantaneous rate of decay for biodegradation; and a linear sorption rate. The model is capable of simulating a continuous contaminant source or a decaying source at a selected first-order biodegradation rate.

5.4.1 Model Calibration

Calibration of the semi-analytical fate and transport model is an important component in the development of a defensible groundwater model. It demonstrates that the model is capable of predicting actual observed hydraulic and chemical conditions either observed

in the past or present. Two groundwater model calibrations were performed for the shallow surficial aquifer and one groundwater model calibration was performed for the deeper semi-confined aquifer. The simplifying assumptions used for each model calibration are described in the following sections.

5.4.1.1 Surficial Aquifer Calibration

Model calibration was simplified by choosing chemical and hydraulic characteristics from the southern lobe of the groundwater BTEX plume, which emanates from the mobile LNAPL source in the vicinity of TW-1105. The maximum BTEX concentrations in groundwater and measurable mobile LNAPL were detected from this lobe of the BTEX plume. For modeling purposes, it is assumed that the northern lobe of the plume acts similarly to the southern lobe. This assumption is conservative because the magnitude of contamination in the northern lobe is much lower than in the southern lobe.. Furthermore, the microbial destruction of BTEX compounds in the northern half of the plume is indicated by geochemical indicator data in the form of reduced DO and sulfate, and increased concentrations of ferrous iron and manganese relative to background (Section 4.5.2).

The analytical flow model for the surficial aquifer was calibrated using March 1996 data. Previous groundwater BTEX data was not available for model calibration because historic data sets were generally incomplete as a result of well abandonment or the presence of LNAPL. In the case of the former, monitoring wells TW-1108 and CPT-22 were temporary monitoring wells (located in the source area of the groundwater BTEX plume near TW-1105) abandoned after initial sampling and analysis. In the case of the latter, monitoring well TW-1105 was historically not sampled during each sampling event because of the presence of mobile LNAPL.

Because historic groundwater BTEX data in the southern lobe of the BTEX plume is limited, whether the plume in the surficial aquifer is shrinking, expanding, or at steady-state remains unconfirmed. However, available data suggest that the BTEX plume is transitioning from a steady-state/expanding plume to a steady-state/shrinking plume for two reasons: 1) fueling operations at the BX Shoppette ceased in December 1992, and all site USTs were removed in September 1995, thereby eliminating the potential for a continuing spill source; and 2) BTEX concentrations at monitoring well TW-1110 (located approximately 90 feet east of and potentially downgradient from the source area)

have steadily decreased from 59,000 µg/L to 7,660 µg/L since January 1992. These conditions indicate that continued LNAPL buildup in soils is impossible and that the dissolution of BTEX compounds from existing LNAPL may be decreasing through weathering. As the LNAPL continues to weather and the bioslurper continues to operate, the potential increases for the plume to shrink. Because bioslurping began at the site six months after the collection of the March 1996 data, the effects of bioslurping were not evaluated in the initial groundwater model calibration. However, the effects of bioslurping on the persistence of the BTEX plume were evaluated in later model scenarios through modifications to the calibrated model.

Considering the groundwater hydraulics and source characteristics of the site, site conditions of the surficial aquifer were modeled with steady-state groundwater hydraulics and a steady-state source. A relatively high groundwater gradient and hydraulic conductivity were used in the Bioscreen model to account for contaminant migration in any possible direction under "worst-case" conditions. Furthermore, calibrating to a steady-state plume is conservative if the BTEX plume is shrinking. The conservative, steady-state assumption compensates for a loss of calibration accuracy caused by complex site conditions.

The surficial aquifer model (BX1SCAL) was successfully calibrated to reproduce the maximum BTEX concentrations observed at the source area (84,900 µg/L at well TW-1105) with an estimated biodegradation rate of 0.0062 day^{-1} (Section 5.3.5.3). Modeled concentrations along the plume centerline could not be precisely matched with the observed concentrations; as would be expected given the conservative model assumptions, the modeled concentrations were higher than actual observed concentrations. For instance, modeled BTEX concentrations exceeded observed BTEX concentrations downgradient from the plume source at monitoring well TW-1110 and monitoring point ESMP-6S by approximately 2,700 µg/L and 64 µg/L, respectively. Consequently, the total dissolved contaminant mass predicted by the model is higher than the mass estimated from the observed contaminant concentrations. The modeled BTEX plume extends approximately 480 feet downgradient from the plume source to the 1-µg/L concentration, resulting in a length for the modeled plume that is approximately 150 feet longer than the southern lobe of the BTEX plume observed in March 1996. Calibrated model input data are summarized in tabular form in Appendix D. Model input and output are also included in Appendix D.

To achieve a better match between observed and modeled BTEX concentrations along the plume centerline, a second calibration model, BX2SCAL, was performed. This calibration was identical to BX1SCAL except that the biodegradation rate was increased to 0.011 day^{-1}. Model BX2SCAL very closely matches observed BTEX values along the plume centerline, while maintaining the source concentration of 84,900 µg/L measured at monitoring well TW-1105. The maximum downgradient distance for BTEX contamination in model BX2SCAL is 350 feet, which is within 20 feet of the estimated downgradient distance of BTEX contamination on the basis of the southern lobe of the BTEX plume observed in March 1996. Model input and output are included in Appendix C.

Models BX1SCAL and BX2SCAL both provide good model calibrations for groundwater contamination at the BX Shoppette. Model BX1SCAL has the advantage of providing a level of conservatism that offsets any site conditions that have not been accounted for during model calibration. The disadvantage of model calibration BX1SCAL is that the model may overestimate BTEX migration and persistence; BTEX contamination may, in fact, be more rapidly biodegraded. In contrast, model BX2SCAL may provide more realistic simulations of the BTEX plume migration and persistence, but may underestimate BTEX migration and persistence in the event that some unidentified factor results in more rapid transport. Both calibrated models were used to estimate future BTEX plume configurations under varying assumptions regarding engineered remediation technologies at the site. These results are proved in Section 5.4.2.

5.4.1.2 Semi-Confined Aquifer Calibration

Several simplifying assumptions were used in the model calibration for the deeper sand aquifer (Model BX1DCAL). These assumptions were used because an insufficient number of monitoring wells screened in the sand aquifer exist in the source area to characterize BTEX concentrations beneath the source area. Intermittent BTEX detections at monitoring wells in this aquifer peripheral to the source of contamination in the shallow aquifer suggest that this aquifer is impacted. For example, 81.9 µg/L and 40 µg/L of total BTEX were detected at monitoring wells MW-1124 (August 1995) and MW-1125 (November 1995), respectively. However, only monitoring well MW-1125 contained BTEX contamination (1 µg/L) in March 1996. BTEX contamination also was detected at concentrations of 35.4 µg/L and 7.5 µg/L at monitoring wells MW-1127 and

MW-1128, respectively, in March 1996. The variability of BTEX detections in deep monitoring points suggests that BTEX migrating to the deep aquifer may be affected by variations in the potentiometric surface that draw BTEX into the aquifer through seasonal fluctuations. In addition, previous detections of BTEX that were not confirmed in the same wells in March 1996 suggest that these BTEX concentrations may have biodegraded or been diluted below levels of concern.

The deeper semi-confined aquifer model was successfully calibrated using very conservative assumptions about the BTEX source strength and biodegradation rate. The starting BTEX concentrations in the source area of the calibrated model for the sand aquifer were set at 1,000 μg/L, which exceeds the highest observed BTEX concentration by an order of magnitude. Hydraulic conductivity, groundwater gradient, dispersivity, and retardation were determined as described in Sections 5.3.1 to 5.3.3. The biodegradation rate was set at 0.0001 day^{-1} as discussed in Section 5.3.5. Calibrated model input and output are included in Appendix D.

5.4.2 Modeled Source Reduction in the Surficial Aquifer

Bioscreen can simulate decreases in a BTEX source by assuming that the rate of BTEX dissolution into groundwater (a natural weathering process) can be approximated by a first-order process. To accomplish this, the Bioscreen model assumes the following: 1) there is a finite mass of BTEX in the source zone present as mobile or residual and mobile LNAPL; and 2) the finite LNAPL body in the source zone dissolves as fresh groundwater passes through the aquifer matrix. Therefore, the continuous dissolution of BTEX into groundwater causes a decrease in LNAPL BTEX concentrations in the source area, thereby, decreasing the amount of BTEX available for future dissolution into groundwater. The time required for the BTEX concentration in LNAPL to reach one-half of the original concentration (i.e., half-life) may be used by Bioscreen to estimate a first-order source decay (or weathering) rate. Since groundwater velocity and discharge are constant in the Bioscreen model, the half-life of BTEX concentrations contained in LNAPL is dependent on the starting mass of BTEX. Therefore, different source-decay rates can be achieved by manipulating the starting mass of BTEX in the Bioscreen model. For instance, groundwater throughput in models BX1SCAL and BX2SCAL is sufficient to transport approximately 17.3 kg of dissolved BTEX per year away from the source area. Therefore, the LNAPL BTEX masses of 499, 104, and 35 kg were used to achieve

source decay rates of 5, 20, and 50 percent per year, respectively. The use of these different source decay rates in model simulations are discussed in the following paragraphs.

Calibrated models BX1SCAL and BX2SCAL were used to incorporate source decay rates of 5, 20, and 50 percent per year corresponding to first-order decay half-lives of 14.4, 3, and 1 year(s), respectively. A range of source decay rates was considered to reflect impacts of current bioslurping operations at the site. Bioslurping operations have the dual benefit of mobile LNAPL removal and soil venting around the extraction wells. The forced aeration (bioventing) caused by the action of the bioslurper has been demonstrated to enhance natural biodegradation within a 15- to 250-foot radius of the extraction well (Kittel *et al.*, 1995). In situations where soils are sufficiently aerated, as in the case of bioventing, source decay rates averaging over 90 percent per year have been observed in vadose zone soils at a group of 16 other Air Force sites (AFCEE, 1994).

Model scenarios BX1SMODA and BX2SMODA were based on calibrated models BX1SCAL and BX2SCAL, respectively, but each used a decaying source term of 5 percent per year. This source reduction rate represents limited source removal through bioslurping with secondary bioventing such that source contamination is reduced by 50 percent every 14.4 years. High source decay rates of residual LNAPL would be expected with conventional bioventing systems and only at capillary fringe soils where a falling or fluctuating water table may be present. Considering the potential bioslurping/bioventing-induced loss of contaminants combined with natural weathering of LNAPL, a reduction of 50 percent every 14.4 years is likely a low estimate. Model BX1SMODA suggest that BTEX contamination in the source area will persist for at least 200 years before achieving the federal MCL for benzene of 5 μg/L in the source area. The BTEX plume length measured from the source to the downgradient plume edge (1 μg/L) is not predicted to exceed 500 feet. The length of the BTEX plume is not expected to begin receding within the next 20 years (calendar year 2016), at which time it will be approximately 450 feet from the plume source. Model BX2SMODA uses the same source degradation rate; therefore, it also suggests that BTEX contamination in the source area will persist for at least 200 years before achieving the federal MCL of 5 μg/L for benzene in the source area. Based on the higher dissolved BTEX biodegradation rate in BX2SMODA, the BTEX plume is predicted to start receding within 10 years, or by calendar year 2006, at which time the downgradient edge of the plume will be approximately 350 feet from the plume source.

An increase in the source decay rate to 20 percent per year in the model scenarios presents a more reasonable scenario of site conditions due to the implementation of bioslurping, especially if the water table is stable or rising. Models BX1SMODB and BX2SMODB (based on calibrated models BX1SCAL and BX2SCAL) take advantage of this potential scenario and assume a source reduction rate of 50 percent every 3 years (20 percent per year biodegradation rate). Both models predict that BTEX contamination in the source area will require approximately 40 years before the federal MCL for benzene of 5 µg/L is achieved. Model BX1SMODB predicts that the length of the BTEX plume will begin receding in 10 years (calendar year 2006), at which time the downgradient edge will be approximately 450 feet from the plume source. Model BX2SMODB predicts a quicker BTEX plume length recession. The assumed BTEX plume length is predicted to begin receding by the year 2002, at which time the downgradient edge of the plume will be approximately 350 feet from the plume source.

The final source reduction rate used in model scenarios assumes a 50 percent source reduction every year to model the potential effects of efficient LNAPL recovery through bioslurping with effective secondary bioventing given a water table that is falling or fluctuating. Because groundwater levels have been documented to fluctuate by as much as 4 feet at the site, the average annual rate of 50 percent may be the most realistic scenario given the probability of remediation of the source area and capillary soils through bioslurping within the next few years. Models BX1SMODC and BX2SMODC incorporate a 50-percent-per-year biodegradation rate (half-life of 1 year) of contamination in the source zone. BTEX concentrations in the source area in both models are predicted to reach the federal MCL for benzene of 5 µg/L within approximately 14 years (calendar year 2010). Model BX1SMODC predicts that the recession of the plume length will occur in approximately 10 years (by calendar year 2006). In contrast, model BX2SMODC predicts a much more rapid recession of the plume source. The BTEX plume is predicted to begin receding in approximately 6 years (calendar year 2002), and for the leading edge to recede within approximately 350 feet from the plume source. After 14 years (calendar year 2010), the leading edge of the plume is predicted to have receded to approximately 100 feet from the source area. Input and output data for all shallow aquifer simulation are included in Appendix D.

5.4.3 Modeled Contaminant Reduction In the Semi-Confined Aquifer

For purposes of groundwater modeling in the deeper sand aquifer, it was assumed the projection of calibrated model BX1DCAL into the future adequately estimates potential fate and transport in the semi-confined aquifer. This "worst-case" model includes the same conservative assumptions for biodegradation rate and source strength, as discussed in Section 5.4.1.2. Model BX1DCAL predicts that groundwater BTEX contamination will not migrate further than 210 feet from the source area in the vicinity of TW-1105 within 200 years. This extremely low migration potential is largely due to very low hydraulic gradients at the site. Assuming that the groundwater gradient is an order of magnitude greater than observed at the site (0.0026 ft/ft as compared to the observed 0.00026 ft/ft gradient), BTEX contamination is not predicted to migrate farther than 1,000 feet downgradient within the next century (model BX1DCALA). Therefore, the migration potential for BTEX in the deep aquifer is predicted to be very low. Even if significant BTEX contamination were to breach the confining layer separating the surface aquifer from the deeper aquifer, the slow groundwater velocity in the sand aquifer would prevent significant downgradient migration of BTEX.

5.5 SENSITIVITY ANALYSIS

The purpose of a sensitivity analysis is to determine the effect of varying model input parameters on model output. The sensitivity analysis for the BX Shoppette model was conducted on individual runs of model BX1SCAL by varying hydraulic conductivity (both multiplied and divided by 5), the biodegradation rate (both multiplied and divided by 2), retardation (±25%), and dispersivity (both multiplied and divided by 2). To perform the sensitivity analyses, model BX1SCAL was run for a 10-year period with the same input as the calibrated model excluding the tested parameter. Model output data and figures from the sensitivity analysis are presented in Appendix D.

The results of the sensitivity analysis suggest that the calibrated model is most sensitive to hydraulic conductivity and biodegradation rate. Increasing hydraulic conductivity increases the distance of plume migration, while decreasing this variable decreases the distance of plume migration. Conversely, increasing the biodegradation rate reduces the distance of plume migration, while decreasing this variable increases the distance of plume migration. The worst-case scenario in the sensitivity analysis is the increase in hydraulic conductivity by 5 times. However, even with this worst-case

situation, groundwater BTEX contamination at concentrations above 5 μg/L is not predicted to migrate farther than 1,500 feet downgradient from the source area.

The Bioscreen model is least sensitive to dispersivity and retardation (contaminant sorption). Increases in either the dispersivity or TOC concentrations (affecting retardation) had only minor effects on the modeled BTEX plume.

5.6 CONCLUSIONS AND DISCUSSION

Model scenarios for the shallow aquifer were based on two calibrated models to provide a range of predictions for groundwater plume migration. The only difference between the calibrated models was the biodegradation rate. A biodegradation rate calculated using the method of Buscheck and Alcantar (1995) was used in model BX1SCAL, whereas a calibrated biodegradation rate corresponding to a best plume fit was used in model BX2SCAL. Calibrated model BX1SCAL used a lower biodegradation rate of 0.0062 day^{-1} and presents a worst-case scenario for contaminant migration. The model was calibrated under steady-state conditions and predicts that the plume front will maintain a distance that is less than 500 feet downgradient from the source area (150 feet beyond the current position of the downgradient edge of the BTEX plume).

The current operation of a bioslurping system at the BX Shoppette and its effects on plume reduction were evaluated with six model scenarios. Three model scenarios examined a range of source reduction rates from 5 to 50 percent per year [source half-lives of 14.44 to 1 year(s)] with a dissolved BTEX biodegradation rate set at a constant 0.0062 day^{-1} (based on calibrated model BX1SCAL). The remaining three model scenarios for the shallow aquifer examined the same range of source reduction rates, but with a dissolved BTEX biodegradation rate set at a constant 0.011 day^{-1} (based on calibrated model BX2SCAL).

Source reduction rates of between 5 and 50 percent will result in time frames of 200 to 14 years until BTEX concentrations of 5 μg/L or less are achieved. A moderate source reduction rate of 20 percent per year will result in a period of 40 years to achieve 5 μg/L or below. Plumes in the shallow aquifer are expected to begin receding within the next 6 to 20 years. Plumes are not predicted to expand further than 500 feet downgradient, even under the most conservative circumstances.

BTEX contamination in the deeper sandy aquifer is not predicted to have far-reaching impacts. Under current conditions, BTEX contamination is not predicted to migrate more than 200 feet further downgradient (southwest) within 200 years. An order-of-magnitude increase in the groundwater gradient of the semi-confined aquifer equates to only 1,500 feet of migration in a century. The biodegradation potential of the deep aquifer is suspected to be greater than predicted by the 0.0001 day^{-1} biodegradation rate, thereby limiting BTEX migration potential predicted by the model.

The removal of BTEX compounds predicted by the simulations is largely a function of aerobic and anaerobic biodegradation. In all cases, model simulations are conservative for several reasons, including those listed below:

1) The shallow groundwater model assumes a homogeneous, isotropic sandy aquifer for groundwater flow. However, the site hydrogeology is heterogeneous and anisotropic with respect to the intermittent sand, silty sand, and clay zones present at the site. Lower groundwater velocities are likely where groundwater passes through zones of differing hydraulic conductivities, especially in the case of silty sands and clays.

2) The calibrated models conservatively assumed steady-state hydraulics and contaminant source loading. Groundwater flow is expected to fluctuate in direction (especially in the shallow aquifer), thereby reducing the potential for contaminant migration in any single direction. The groundwater models assume continuous flow in one direction, maximizing the greatest predicted migration distance.

3) The solute decay constants (0.0062 and 0.011 day^{-1}) covering both aerobic and anaerobic processes are conservative with respect to literature values of 0.001 to 0.185 day^{-1} for anaerobic decay alone(see Section 5.3.5.3). The assumed biodegradation rate of 0.0001 day^{-1} used in model calibrations for the deeper aquifer is very low with respect to literature values. The use of a low solute decay constant increases the amount of time required for natural processes to completely attenuate the BTEX contamination. Consequently, the simulated dissolved BTEX contamination is capable of migrating greater distances downgradient before destruction.

4) A low coefficient of retardation for benzene (1.4) was used for all the BTEX compounds in both the shallow and semi-confined aquifer model simulations. Benzene is the least sorptive of the BTEX compounds and, therefore, is the most mobile. The use of a conservative retardation coefficient tends to increase the velocity of contaminant migration, but may provide a more accurate estimate of benzene transport. However, realistic retardation coefficients for toluene, ethylbenzene, and xylenes are higher than that for benzene, and the migration of these compounds will be slowed, thereby increasing their susceptibility to biodegradation for a given downgradient migration distance.

5) Aerobic biodegradation may potentially become more important in the shallow aquifer as mobile and residual LNAPL concentrations are removed, an as incidental bioventing during bioslurping operations introduces more oxygen into soils at the vadose zone. Furthermore, the eastern extent of the shallow aquifer BTEX plume may receive additional oxygen due to drainage waters entering the aquifer from the northwest/southeast flowing canal bordering the site.

6) The baseline calibrated model BX1SCAL for the shallow aquifer and model BX1DCAL for the semi-confined aquifer were calibrated such that whenever the calibrated concentrations did not match observed calibrations at a given location, the calibrated concentration was higher. This results in a greater modeled BTEX mass than estimated from observations. Consequently, the time required for natural attenuation processes to degrade simulated mass of the contamination is increased, and the potential downgradient migration distance is overpredicted.

The ranges in times and travel distances required for degradation and stabilization of the BTEX plumes observed in the six model simulations for the shallow aquifer are feasible (and likely conservative), given the observed BTEX concentrations, the conservative assumptions made in constructing the simulations, and the strong geochemical evidence of aerobic and anaerobic biodegradation.

Calibrated model BX1SCAL provides the "worst-case" scenario for the length of time required for RNA to completely remediate groundwater contamination because no source

reduction is assumed. However, with a pilot-scale bioslurping system in operation at the site, and given natural weathering, source reduction is occurring. Consequently, variations of BX1SCAL which incorporate 5- to 50-percent rates of annual source reduction (models BX1SMODA through BX1SMODC) after September 1996 are plausible. Variations of model BX2SCAL, which incorporate 5- to 50-percent rates of annual source reduction (BX2SMODA through BX2SMODC) may be more realistic examples of future plume reduction because they best match current site conditions. On the basis of these models and given the active source remediation at the site, it is likely that source reduction might be necessary for between 10 and 20 years. However, the practical benefit from site remediation through bioslurping (or other active remedial technologies) is realized within 5 years, and the actual amount of time necessary for source reduction is suspected to be within this time frame. Even without engineered source removal, groundwater BTEX concentrations are not expected to migrate further than 500 feet downgradient from the source area near TW-1105. Furthermore, low groundwater gradients in the deeper sand aquifer are expected to limit groundwater BTEX plume travel in this water-bearing unit to within several hundred feet of the source area almost indefinitely.

SECTION 6

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents the development and comparative analysis of three groundwater remedial alternatives for the former BX Shoppette at Eaker AFB. The intent of this evaluation is to determine if RNA is an appropriate and cost-effective remedial approach to consider when developing final remedial strategies for the site, especially when combined with other conventional remedial technologies.

Section 6.1 presents the evaluation criteria used to evaluate groundwater remedial alternatives. Section 6.2 discusses the factors influencing the development of remedial alternatives considered as part of this demonstration project. Section 6.3 provides a brief description of each of these remedial alternatives. Section 6.4 provides a more detailed analysis of the remedial alternatives using the defined remedial alternative evaluation criteria. The results of this evaluation process are summarized in Section 6.5.

6.1 REMEDIAL ALTERNATIVE EVALUATION CRITERIA

The evaluation criteria used to identify appropriate remedial alternatives were adapted from those recommended by the USEPA (1988) for selecting remedies for Superfund sites (Office of Solid Waste and Emergency Response [OSWER] Directive 9355.3-01). These criteria include (1) long-term effectiveness and permanence, (2) technical and administrative implementability, and (3) relative cost. The following sections briefly describe the scope and purpose of each evaluation criterion. This report focuses on the potential use of RNA and source reduction technologies to reduce BTEX within the shallow groundwater to concentrations that do not exceed regulatory action levels.

6.1.1 Long-Term Effectiveness and Permanence

Each remedial technology or remedial alternative (which can be a combination of remedial approaches such as RNA and institutional controls) was analyzed to determine the effectiveness of meeting remedial action goals. Technical effectiveness was evaluated based on case histories from other sites with similar conditions. The ability to minimize potential impacts on surrounding facilities and operations was considered. Also, the ability of each remedial alternative to protect current and potential future receptors from potential risks associated with potential exposure pathways was qualitatively assessed. These evaluation criteria also include permanence of the remedy,

and the ability to reduce contaminant mass, toxicity, and volume. The time required for implementation and for achieving remedial action objectives are discussed. Long-term reliability for providing continued protection, including an assessment of potential for failure of the technology and the potential threats resulting from such a failure, also was evaluated.

6.1.2 Implementability

Implementability of each remedial technology or remedial alternative includes an evaluation of technical as well as administrative feasibility. Potential shortcomings and difficulties in construction, operations, maintenance, and monitoring are presented and weighed against perceived benefits. Requirements for any post-implementation site controls, such as LTM and land use restrictions, are described. Details on administrative feasibility in terms of the likelihood of public acceptance and the ability to obtain necessary approvals are discussed.

6.1.3 Cost

The total cost (present worth) of each remedial alternative was estimated for relative comparison following USEPA (1988 and 1993a) guidance. An estimate of capital costs, and operations and maintenance costs for site monitoring and controls is included. An annual adjustment factor of 7 percent was assumed in present worth calculations (USEPA, 1993a). The annual adjustment factor is the difference between the rate of inflation and the cost of money (USEPA, 1988).

6.2 FACTORS INFLUENCING ALTERNATIVES DEVELOPMENT

Several factors were considered during the identification and screening of remedial technologies for addressing shallow groundwater contamination at the former BX Shoppette at Eaker AFB. Factors considered included the objectives of the natural attenuation demonstration program; contaminant, groundwater, and soil properties; current and future land uses; current remedial activities (i.e., bioslurping); and potential receptors and exposure pathways. The following sections briefly describe each of these factors and how they were used to narrow the list of potentially applicable remedial technologies to the final remedial alternatives considered for the site.

6.2.1 Program Objectives

The intent of the RNA demonstration program sponsored by AFCEE is to develop a systematic process for scientifically investigating and documenting naturally occurring

subsurface, chemical attenuation processes that can be factored into overall site remediation plans. The objectives of this program and the specific study at the BX Shoppette are to provide solid evidence for RNA of dissolved fuel hydrocarbons so that this information can be used to develop an effective groundwater remediation strategy. A secondary goal of this multi-site initiative is to provide a series of regional case studies that demonstrate that natural processes of contaminant degradation can often reduce contaminant concentrations in groundwater to below acceptable cleanup standards before completion of potential receptor exposure pathways.

Because the objective of this program is to study natural processes in the saturated zone rather than all contaminated media (e.g., soil, soil gas, etc.), technologies have been evaluated based on their potential impact on shallow groundwater and phreatic soils. Technologies that can reduce vadose zone contamination and subsequent partitioning of contaminants into groundwater also have been evaluated. Source removal technologies evaluated in this section will reduce soil and soil gas contamination, but it is important to emphasize that the remedial alternatives developed in this document are not intended to remediate all contaminated site media. Nevertheless, remediation of contamination in the vadose zone can reduce contaminant leaching, further increasing the effectiveness of natural attenuation mechanisms in groundwater.

Additional AFCEE program objectives include developing cost effective remediation strategies and minimization of remediation waste. Through evaluation of petroleum-contaminated sites nationwide, EPA and the US Air Force (USAF) have identified technologies that meet these criteria and include institutional controls, SVE, bioventing, biosparging, bioslurping, and RNA (USEPA and US Air Force, 1993b). Other remedial measures with potentially greater costs or associated liability include soil excavation, slurry walls, sheet piling, carbon adsorption, *ex situ* biological or chemical treatment, groundwater pump and treat, and onsite/offsite disposal, which are generally not considered attractive technologies under this program.

6.2.2 Contaminant Properties

The site-related contaminants considered as part of this demonstration at the former BX Shoppette are the BTEX compounds. The source of this contamination is gasoline present as mobile and residual LNAPL in the vadose zone, capillary fringe, and saturated soil on the site. The physiochemical characteristics of the fuels and the individual BTEX compounds will greatly influence the effectiveness and selection of a remedial technology.

Gasoline is classified as an LNAPL with a liquid density of approximately 0.73 g/cc at 20°C [Biomedical and Environmental Information Analysis (BEIA), 1989]. Because gasoline is less dense than water, the LNAPL may become concentrated in the capillary fringe. Some of the individual gasoline constituents preferentially adsorb onto the soil matrix, while others dissolve quickly into percolating groundwater, and yet others may volatilize into soil vapor. This "weathering" process results in a variable distribution of individual gasoline components in the soil, soil atmosphere, and groundwater with time and distance from the release (BEIA, 1989). Constituents in gasoline range from slightly to highly soluble in water. Overall solubility is approximately 300 mg/L. Gasoline also can act as a primary substrate for microbiological metabolism. Simultaneous biodegradation of aliphatic, aromatic, and alicyclic hydrocarbons has been observed. In fact, mineralization rates of hydrocarbons in mixtures, such as gasoline, may be faster than mineralization of isolated constituents as a result of cometabolic pathways (Jamison *et al.*, 1975; Perry, 1984).

The BTEX compounds are generally volatile, highly soluble in water, and adsorb less strongly to soil than other hydrocarbons in the petroleum mixture. These characteristics result in leaching of the BTEX compounds from contaminated soil into groundwater and migration as dissolved contamination (Lyman *et al.*, 1992). All of the BTEX compounds are highly amenable to *in situ* degradation by both biotic and abiotic mechanisms.

Benzene is very volatile with a vapor pressure of 76 millimeters of mercury (mm Hg) at 20°C and a Henry's Law Constant of approximately 0.0054 atmosphere-cubic meters per mole (atm-m^3/mol) at 25°C (Hine and Mookerjee, 1975; Jury *et al.*, 1984). The solubility of pure benzene in water at 20°C has been reported to be 1,780 mg/L (Verschueren, 1983). Benzene will biodegrade by naturally-occurring subsurface microorganisms to carbon dioxide, with catechol as a short-lived intermediate (Hopper, 1978; Ribbons and Eaton, 1992).

Toluene is also volatile, with a vapor pressure of 22 mm Hg at 20°C and a Henry's Law Constant of about 0.0067 atm-m^3/mol at 25°C (Pankow and Rosen, 1988; Hine and Mookerjee, 1975). Toluene sorbs more readily to soil media relative to benzene, but still is very mobile. The solubility of pure toluene in water at 20°C is approximately 515 mg/L at 20°C (Verschueren, 1983). Toluene has been shown to degrade by naturally occurring subsurface microorganisms to pyruvate, caetaldehyde, and completely to carbon dioxide via the intermediate catechol (Hopper, 1978; Wilson *et al.*, 1986; Ribbons and Eaton, 1992).

Ethylbenzene has a vapor pressure of 7 mm Hg at 20°C and a Henry's Law Constant of 0.0066 atm-m^3/mol (Pankow and Rosen, 1988; Valsaraj, 1988). Ethylbenzene sorbs more strongly to soils than benzene but less strongly than toluene (Abdul *et al.*, 1987). Pure ethylbenzene is also less soluble than benzene and toluene in water at 152 mg/L at 20°C (Verschueren, 1983; Miller *et al.*, 1985). Ethylbenzene is ultimately degraded by natural subsurface microorganisms to carbon dioxide via its intermediate 3-ethylcatechol (Hopper, 1978; Ribbons and Eaton, 1992).

The three isomers of xylene have vapor pressures ranging from 7 to 9 mm Hg at 20°C and Henry's Law Constants of between 0.005 and 0.007 atm-m^3/mol at 25°C (Mackay and Wolkoff, 1973; Hine and Mookerjee, 1975; Pankow and Rosen, 1988). Of all of the BTEX compounds, xylenes sorb most strongly to soil, but still can leach from soil into the groundwater (Abdul *et al.*, 1987). Pure xylenes have water solubilities of 152 to 160 mg/L at 20°C (Bohon and Claussen, 1951; Mackay and Shiu, 1981; Isnard and Lambert, 1988). Xylenes can be degraded by natural subsurface microorganisms to carbon dioxide via pyruvate carbonyl intermediates (Hopper, 1978; Ribbons and Eaton, 1992).

Therefore, remediation technologies identified in the EPA and USAF remediation technologies screening matrix guide (USEPA and USAF, 1993b) for BTEX compounds in soil and groundwater area generally effective due to the volatile or biodegradable nature of these compounds. For example, SVE and groundwater extraction/air stripping involve physical volatilization of BTEX compound from soil and groundwater, respectively. Natural attenuation, bioventing, bioslurping and biosparging remedial systems are effective due to the biodegradability of BTEX compounds, while potentially optimizing the volatilization of these contaminants (i.e., bioventing and biosparging). Bioslurping is effective due to the removal of mobile LNAPL, as well as simultaneous enhancement of volatilization and biodegradation. Therefore, RNA, SVE, bioventing, bioslurping, biosparging, and groundwater extraction/air stripping technologies could all be effective at collecting, destroying, and/or treating BTEX contaminants at the BX Shoppette.

6.2.3 Site-Specific Conditions

Three general categories of site-specific characteristics were considered when identifying remedial technologies for comparative evaluation as part of this demonstration project. The first category was physical characteristics such as groundwater depth, gradient, flow direction, and soil type. The second category was site

geochemistry, such as the interaction of site contaminants with electron acceptors, microorganisms, and other site contaminants. Both of these categories influence the types of remedial technologies most appropriate for the site. The third category involved assumptions about future land use and potential receptors and exposure pathways. Each of these site-specific characteristics have influenced the selection of remedial alternatives included in the comparative evaluation.

6.2.3.1 Physical Characteristics

Site geology and hydrogeology will have a profound effect on the transport of contaminants at a given site, as well as the effectiveness and scope of required remedial technologies at a given site. Hydraulic conductivity is perhaps the most important aquifer parameter governing groundwater flow and contaminant transport in the subsurface. The velocity of the groundwater and dissolved contamination is directly related to the hydraulic conductivity of the saturated zone. Estimated hydraulic conductivity values at the BX Shoppette from five shallow site wells ranged from 0.04 to 13.94 ft/day and are characteristic of silt/silty sand to dirty sand (Freeze and Cherry, 1979). Low hydraulic conductivity values are representative of the silty/clayey sand intervals at the site. Estimated hydraulic conductivity values from four site wells screened in the deep, semi-confined sand aquifer ranged from 2.86 to 5.7 ft/day and are characteristic of clean to dirty sands (Freeze and Cherry, 1979).

The soils comprising the shallow aquifer are very heterogeneous, and the likelihood that continuous sandy or silty sand layers act as preferential flow paths is minimal. Sand lenses in the shallow aquifer appear to be discontinuous. Groundwater BTEX migration is contrary to the groundwater flow direction (Figure 4.4). Groundwater BTEX migration is to the east/southeast (Figure 4.5) and potentially contacts the northwest/southeast-flowing drainage canal at the periphery of the BTEX plume. The elevations of the beds of the canals that border the site vary between 242 to 243 feet msl, which is higher than shallow groundwater elevations in the source area. Therefore, the hydraulic potential for groundwater discharge to the drainage canals appears limited to incidents that cause groundwater elevation increases (seasonal precipitation or regional flood control measures). Surface water contamination was detected at a single location at 0.5 μg/L of toluene upstream from the site (SUR1) and suggests that groundwater BTEX contamination is not impacting the canal. Furthermore, mobile LNAPL sheens have not been observed in either drainage canal adjacent to the site, suggesting that a pathway for the migration of mobile LNAPL in the vadose zone to the canals is not complete.

Perched groundwater is suspected to be present at the site, which may be causing the elevated groundwater conditions observed at monitoring wells MW-1114, TW-1115, ESMP-2S, ESMP-3S, and ESMP-8S. These conditions suggest a silty clay/clay layer that extends above the groundwater table with the potential to both collect precipitation recharge and cause a barrier to groundwater flow. Figures 3.1 through 3.3 illustrate such layers of clay and silty/clay extending above the shallow groundwater table. These geologic layers will act as barriers to groundwater flow and will channel downgradient migration of contaminants through permeable stringers of sand (mostly discontinuous) or layers of silty sand. In this case, the impact of dispersion on natural attenuation of BTEX will be limited.

The existence of an apparent groundwater depression at the site and geologic barriers to groundwater flow affect the fate and transport of the contaminant plume and the processes of natural attenuation. Residence times for dissolved hydrocarbon contamination in the shallow aquifer are expected to be extended, which increases the potential for natural biodegradation of contaminants before migration from the source area. Oxygen that may be utilized for biodegradation of BTEX compounds is likely to be supplied from recharge from the adjacent drainage canals that may migrate into the source area (from the northeast/southwest drainage canal) will add oxygen to the groundwater plume, which is migrating east toward the canal recharge areas.

Site geology and hydrogeology also impact the types of remedial technologies under consideration. For example, engineered solutions for plume containment are simplified because site geology provides partial plume containment. On the other hand, the radius of influence of a bioventing system may be limited because of surrounding intervals of low-permeability silty clays and clays. Subsurface air flow induced by a bioventing system likely will channelize along higher permeability sands and silts. This is a perceived benefit of bioventing, because the majority of mobile and residual LNAPL is expected to reside in the higher permeability sands and silts and would be treated through bioventing. Similarly, during the removal of mobile LNAPL using the existing bioslurper, the effects of bioventing would become more pronounced as the vacuum induced by the bioslurper draws oxygen from surrounding soils. This influx of air generated by the bioslurper will enhance mobile LNAPL migration rates and BTEX volatilization toward the extraction well as air flows past the LNAPL. Contaminant recovery also will be influenced by low TOC (<0.07 percent) content in the soil and a corresponding decrease in contaminant sorption to phreatic soil.

The effectiveness of biosparging or groundwater pump and treat would be expected to be severely limited by the geology of the shallow aquifer. Biosparging is most effective in aquifers that are homogenous and permeable and that allow maximum dispersion of air bubbles. Silty clay or clay intervals will short circuit air bubble dispersion, and biosparging would not be expected to achieve meaningful oxygen mass transfer within saturated sand or silty sand lenses. However, excellent BTEX removal rates in the immediate vicinity of the source area would be expected. Low-permeability soils at the site may cause severe drawdown of the groundwater table during pump-and-treat options, which could cause extraction wells to pump dry and result in entrapment of mobile LNAPL below the saturated interval. Low-flow-rate biosparging or pump-and-treat options could be effective remedial alternatives in the homogeneous sands of the lower semi-confined aquifer, if necessary.

6.2.3.2 Geochemical Characteristics

To satisfy the requirements for indigenous microbial activity, the aquifer must provide an adequate and available carbon or energy source, electron acceptors, essential nutrients, and proper ranges of pH, temperature, and redox potential. Data collected as part of the field work phase of this demonstration project and described in Sections 3 and 4 of this document indicate that the BX Shoppette is characterized by adequate and available carbon/energy sources (e.g., fuel contamination) and electron acceptors that support measurable biodegradation by indigenous microorganisms. DO, manganese, ferrous iron, sulfate, and carbon dioxide (which is utilized during methanogenesis) represent significant sources of electron acceptor capacity for the biodegradation of BTEX compounds at the site. Further, because fuel-hydrocarbon-degrading microorganisms have been known to thrive under a wide range of temperature and pH conditions (Freeze and Cherry, 1979), the physical and chemical conditions of the groundwater and phreatic soil at the site are not likely to inhibit microorganism growth.

Fuel-hydrocarbon-degrading microorganisms are ubiquitous, and as many as 28 hydrocarbon-degrading isolates (bacteria and fungi) have been identified in different soil environments (Davies and Westlake, 1979; Jones and Eddington, 1968). Indigenous microorganisms have a distinct advantage over microorganisms injected into the subsurface to enhance biodegradation because indigenous microorganisms are well adapted to the physical and chemical conditions of the subsurface in which they reside (Goldstein *et al.*, 1985). Microbe addition was not considered a viable remedial technology for the BX Shoppette.

6.2.3.3 Potential Exposure Pathways

A pathways analysis identifies the potential human and ecological receptors that could come into contact with site-related contamination, and the pathways through which these receptors might be exposed. To have a complete exposure pathway, there must be a source of contamination, a mechanism(s) of release, a pathway of transport to an exposure point, an exposure point, and a receptor. If any of these elements do not exist, the exposure pathway is considered incomplete, and receptors will not come into contact with site-related contamination. Evaluation of the potential long-term effectiveness of any remedial technology or remedial alternative as part of this demonstration project includes determining the potential for pathway completion. If a competed exposure pathway exists, potential long-term remedial options may still be sufficient to maintain exposure concentrations below regulatory levels.

Assumptions about current and future land use at a site form the basis for identifying potential receptors, potential exposure pathways, reasonable exposure scenarios, and appropriate remediation goals. USEPA (1991b) advises that the land use associated with the highest (most conservative) potential level of exposure and risk that can reasonably be expected to occur should be used to guide the identification of potential exposure pathways and to determine the level to which the site must be remediated. The source area consists of mobile and residual LNAPL in the subsurface beneath the former BX Shoppette. The groundwater contaminant plume originating from the site is migrating primarily to the southeast and has impacted shallow groundwater in an irregularly shaped area within 360 feet of the source area (Figure 4.5). Concrete and asphalt parking areas overlie the core of the plume, and grassy areas overlie the fringes of the contaminant plume. Roadways, maintenance buildings, and office buildings are located on adjacent properties.

A human health risk assessment was conducted for the BX Shoppette as part of the RFI (Halliburton NUS, 1996). The exposure assessment component identified the site as designated for Land Reuse Category C (i.e., commercial, industrial, or recreational property). Hypothetical exposure scenarios for soil and groundwater were evaluated as follows: 1) incidental ingestion, inhalation of contaminants, or dermal contact with subsurface soils by on-site construction workers; and 2) the use of groundwater as drinking water or dermal contact with groundwater by hypothetical on-property adult and child residents.

The qualitative risk assessment did not identify any chemicals that exceeded Region III risk-based concentrations (RBCs) for soil ingestion or dermal screening levels for soil (construction worker). However, BTEX exceeded screening thresholds based on their Region III site-specific levels for transfer from soil to air and/or to groundwater. The individual BTEX compounds were retained as chemicals of potential concern (COPC) in soil. Benzene was identified as a COPC because of its status as a human carcinogen and its exceedance of the site-specific level (SSL) for transfer from soil to air. Toluene, ethylbenzene, and xylene(s) were selected as COPCs solely for their exceedance of the SSLs for transfer from soil to air.

The quantitative risk assessment of COPCs in groundwater for onsite residents produced cumulative noncarcinogenic hazard indices for adult and child receptors ranging from 10^2 to 10^3, which exceed the target threshold of unity. The adult cumulative incremental cancer risk was solely driven by benzene contamination. The incremental cancer risk was 2.8×10^{-2} , which exceeds the USEPA 10^{-4} to 10^{-6} target risk range. Most of the noncarcinogenic and carcinogenic risks from groundwater were from the inhalation exposure pathway (Halliburton NUS, 1996).

The final recommendation of the RFI report for soil contamination at the BX Shoppette with respect to the human health risk assessment was no further action. The final RFI recommendation for groundwater contamination was interim remedial action (IRA) and groundwater modeling as part of a corrective measures study (CMS). The BTEX compounds in groundwater were identified as COPCs for hypothetical residential receptors under residential conditions. However, a residential scenario for groundwater contamination is conservative, and may never be realized because the future land use will most probably be commercial, industrial, or recreational. The bioslurping system fulfills the substantive requirements for an IRA, although bioslurping operations were initiated for a different LNAPL recovery demonstration project.

Groundwater modeling performed for the BX Shoppette and summarized in Section 5 may satisfy the modeling recommendation in the CMS. As discussed in Section 5, conservative groundwater models performed for the site suggest that groundwater contamination may migrate as far as 500 feet from the source area and persist for several decades (with engineered source removal). Therefore, contaminant discharge into the adjacent drainage canal or potential contact with onsite residential receptors via dermal contact or ingestion may be a possibility. However, it is very unlikely that detectable hydrocarbon concentrations will reach the canal, especially as detectable concentrations of BTEX have not been detected previously at locations where the groundwater plume

overlaps the drainage canal (Figure 4.5). Any potential BTEX concentrations reaching the drainage canal would likely be instantly diluted and/or volatilized below analytical detection limits.

The potential for groundwater contact by downgradient receptors or onsite receptors (i.e., well users) is minimal. Shallow groundwater is not currently used to meet any water supply demands at Eaker AFB. Prior to Base closure, Eaker AFB obtained its water from two wells located approximately 4,200 feet southwest of the site (Section 3.4.3). Main water supply wells for the cities of Gosnell and Blytheville and for Eaker AFB all are screened in the Wilcox Formation at depths greater than 1,000 feet bgs. Groundwater contamination in the shallow aquifer poses no significant threat to groundwater resources farther than 500 feet from the source area and is generally limited to the upper 20 feet of the aquifer. Contamination in the deeper sand aquifer is minimal, probably limited to the upper surface of the aquifer (at approximately 30 to 40 feet bgs), and not expected to migrate farther than 1,000 feet downgradient in the next century (under very conservative site conditions). Both plumes are being degraded via physical and biological natural attenuation mechanisms and will eventually be biodegraded. However, the use of RNA at this site will require that restrictions on shallow groundwater use be enforced in the area from the former BX Shoppette and along the northwest/southeast-flowing drainage canals until RNA, or combination of RNA with other technology, achieves site remediation.

6.2.4 Remediation Goals for Shallow and Deep Groundwater

Model results suggest that BTEX compounds are not likely to migrate more than 500 feet from the source area (in any downgradient direction) in the shallow aquifer assuming that present conditions remain steady-state. If active source area remediation is continued (i.e., bioslurping) or implemented (e.g., bioventing or excavation), and as residual LNAPL weathers, groundwater BTEX loading rates will decrease and the dissolved BTEX plume will eventually decrease in concentration and extent. Considering existing plume dimensions and the predicted potential for migration, locations to the east and west of the source area in the shallow aquifer and southwest of the source area in the deeper semi-confined aquifer have been identified as monitoring locations for groundwater remedial activities. In addition, surface water monitoring of the northwest/southeast-flowing creek would be required to assure that impact to surface waters is not occurring from potential groundwater discharge. These are suitable locations for monitoring and for demonstrating compliance with protective groundwater

(and surface water) quality standards (i.e., promulgated federal MCLs and surface water quality standards).

This remedial strategy assumes that compliance with promulgated, single-point remediation goals is not necessary if site-related contamination does not pose a threat to human health or the environment (i.e., if exposure pathways are incomplete). Thus, the magnitude of required remediation in areas that can and will be placed under institutional control is different from the remediation that is required in areas that may be available for unrestricted use. Results of the human health risk assessment suggest that the site poses little risk to potential site receptors under the foreseen industrial usage of the site. Therefore, the primary RAO for shallow or semi-confined groundwater within and downgradient from the former BX Shoppette site is limiting plume expansion to prevent exposure of downgradient receptors to concentrations of BTEX in groundwater at levels that could pose a risk. This means that viable remedial alternatives must be able to achieve concentrations that minimize plume migration and/or expansion. The RAO for shallow groundwater at the POC is attainment of the federal MCLs listed in Table 6.1. Although it is unlikely that surface water or surface water organisms would be ingested by humans, federal ambient water quality criteria could serve as surface water cleanup goals, and are provided in the table for reference.

In summary, available data suggest that there is currently no completed potential exposure pathway for groundwater contamination at the former BX Shoppette to downgradient receptors or onsite receptors. The site is not currently used as a residential area and is not expected to be in the near future. Impact on the northwest/southeast drainage canal is possible; however, BTEX concentrations have not been measured from surface water samples collected from potential groundwater BTEX discharge locations. Moreover, it is unlikely that potential exposure pathways involving shallow groundwater would be completed under future land use assumptions, provided use of groundwater as a potable or industrial source of water is prohibited by institutional controls within the source area and between the source area and the adjacent drainage canals. Thus, institutional controls are likely to be a necessary component of any groundwater remediation strategy for this site. The required duration of these institutional controls may vary depending on the effectiveness of the selected remedial technology at reducing contaminant mass and concentration in groundwater at the source area.

TABLE 6.1
WATER QUALITY STANDARDS
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Compound	Federal Drinking Water MCL (μg/L)[a]	Federal Ambient Surface Water Quality Criterion, Ingestion of Organisms (μg/L)[b]	Federal Ambient Surface Water Quality Criterion, Fresh Water Acute (μg/L)[b]
Benzene	5	71	5,300
Toluene	1,000	29,000	32,000
Ethylbenzene	700	300,000	17,500
Total Xylenes	10,000	Not Available	Not Available

[a] USEPA (1991)
[b] USEPA (1993)

6.2.5 Summary of Remedial Technology Screening

Potential remediation technologies have been screened for technical implementability on the basis of the AFCEE program objectives, the contaminant properties, site-specific conditions, and remediation goals described in Section 6.2.4. Table 6.2 identifies the remedial technologies considered as part of this demonstration and those retained for development and analysis or remedial alternatives. All of the above mentioned factors will influence the implementability of the remedial technologies designed to remediate shallow groundwater underlying and migrating from the site. The remedial approaches retained for development of remedial alternatives and comparative analysis include RNA, bioslurping, bioventing, excavation, institutional controls, and LTM.

6.3 DESCRIPTION OF REMEDIAL ALTERNATIVES

Remedial approaches retained from the screening process were combined into three remedial alternatives for the BX Shoppette. Following a description of each alternative, a comparative analyses of effectiveness, implementability, and cost are presented in Section 6.4.

TABLE 6.2
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION
DEMONSTRATION OF RNA
BX SHOPPETTE (SITE E11)
EAKER AIR FORCE BASE, ARKANSAS

General Response Action	Technology Type	Process Option	Implementability	Retain
Long-Term Monitoring	Periodic Groundwater Monitoring	Long-Term Monitoring Wells	Many existing wells are available to confirm the progress of remediation.	Yes
		Sentry Wells	Sufficient distance exists between the plume and downgradient potable water wells to locate several sentry wells.	Yes
Institutional Controls	Groundwater Use Control	Land Use Control/Regulate Well Permits	Plume area is currently within the Base boundary, and land use and groundwater use are under Base jurisdiction.	Yes
		Seal/Abandon Existing Wells	No production wells are known to exist in the current or predicted plume area.	No
		Point-of-Use Treatment	No groundwater is extracted from the plume area for any use.	No
	Public Education	Meetings/ Newsletters	Base public relations and environmental management offices have many information avenues through which to inform workers and residents.	Yes
Containment of Plume	Hydraulic Controls	Passive Drain Collection	No likely receptors downgradient of site. Installation disruptive to base operations. Long-term maintenance required.	No
		Minimum Pumping/Gradient Control	Surficial aquifer thickness is limited (5 to 10 ft). Pumping groundwater would not be continuous due to dewatering of aquifer and would require treated water disposal. Groundwater depression in the source area creates some natural gradient control.	No
	Physical Controls	Slurry Walls/Grout Curtains	Requires significant disruption of base operations. Limited effectiveness. Contaminant would seek paths over, under, and around wall or curtain. No likely receptors downgradient from site. Limited effectiveness.	No
		Sheet Piling	Same as above.	No
	Reactive/Semi-Permeable Barriers	Biologically Active Zones	Natural biodegradation of BTEX compounds can be stimulated by allowing contaminated groundwater to flow through an aquifer zone which has enhanced oxygen and nutrient conditions. Not practical for excessive contaminant concentrations. Unproven technology. Long-term maintenance required.	No

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TABLE 6.2 (Continued)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION
DEMONSTRATION OF RNA
BX SHOPPETTE (SITE E11)
EAKER AIR FORCE BASE, ARKANSAS

General Response Action	Technology Type	Process Option	Implementability	Retain
In Situ Treatment	Biological	Oxygen and/or Nutrient Enhanced Biodegradation (Biosparging)	Differs from biologically active zone in that oxygen and/or nutrients are injected in source area and allowed to migrate downgradient. Although implementable, the technology may be no more effective than RNA.	No
	Chemical/ Physical	Natural Attenuation	A combination of natural biological, chemical, and physical removal mechanisms which occur to varying degrees on every site. Groundwater sampling at the site indicates that this is a significant, ongoing remediation process.	Yes
		Air Sparging (Volatilization)	Injection of air into contaminated aquifer creating a mass transfer of BTEX into air bubbles and into vadose zone. Most effective for plume containment. Limited radius of influence and short circuiting likely to be a problem.	No
Aboveground Groundwater Treatment	Groundwater Extraction	Vertical Pumping Wells	Entire groundwater plume is pumped by installing numerous wells with submersible pumps. High cost and major disruption to area. Not effective until residual LNAPL is remediated.	No
		Downgradient Horizontal Drains	See Passive Drain Collection (above).	No
	Biological	Bioreactors	High flow rates require excessive retention times and large reactors. BTEX is often volatilized in these systems. Long-term maintenance required.	No
	Chemical/ Physical	Air Stripping	Cost-effective technology for removing varying concentrations of BTEX from groundwater at high flow rates. Permitting for air emissions may be required.	No
		Activated Carbon	Cost prohibitive for more concentrated BTEX. Creates a carbon disposal problem.	No
		UV/Ozone Reactors	High flow rates require excessive retention times and large, expensive reactors. Long-term maintenance required.	No

TABLE 6.2 (Continued)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF
TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION
DEMONSTRATION OF RNA
BX SHOPPETTE (SITE E11)
EAKER AIR FORCE BASE, ARKANSAS

General Response Action	Technology Type	Process Option	Implementability	Retain
Aboveground Treatment	Direct Discharge to Industrial Waste Water Treatment Plant (IWWTP)	IWWTP	Viable option when an IWWTP is available and capable of handling BTEX and hydraulic loading. Groundwater extraction is not planned.	No
Treated Groundwater Disposal	Discharge to IWWTP or Sanitary Sewer	IWWTP	Viable option when access to industrial sewer exists and hydraulic loading is acceptable. Same as above.	No
		Sanitary Sewer	Viable option when access to sanitary sewer exists and hydraulic loading is acceptable. Same as above.	No
	Treated Groundwater Reinjection	Vertical Injection Wells	Injection wells subject to clogging, high maintenance, and permitting. Same as above.	No
		Injection Trenches	Less clogging than wells, but large trenches are required and can be subject to injection well permitting. Same as above.	No
	Discharge to Surface Waters	Storm Drains	Viable option but generally requires discharge permitting. Groundwater extraction is unlikely. Stringent permitting required.	No
Source Removal/Soil Remediation	Mobile LNAPL Recovery	Dual-Pump Systems	Best suited for sites with >1 foot mobile LNAPL and where aboveground groundwater treatment already exists	No
		Skimmer Pumps/Bailers/ Wicks	Low efficiency in mobile LNAPL recovery.	No
		Total Fluids Pumping	Best suited for sites with thin saturated zones where excessive groundwater will not be pumped.	No
		Bioslurping	Combines vapor extraction and mobile LNAPL recovery. System is currently operating at this site.	Yes
		Hand Bailing	The limited quantity of mobile LNAPL at the site makes this method cost-effective on a short-term basis. Low efficiency in mobile LNAPL recovery.	No
	Excavation/ Treatment	Biological Landfarming	Excavation is feasible at this site. Base operates state-permitted landfarm.	Yes

TABLE 6.2 (Concluded)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION
DEMONSTRATION OF RNA
BX SHOPPETTE (SITE E11)
EAKER AIR FORCE BASE, ARKANSAS

General Response Action	Technology Type	Process Option	Implementability	Retain
Source Removal/Soil Remediation (cont'd)	Excavation/ Treatment (cont'd)	Thermal Desorption	Excavation is feasible at this site; however, this technology is no more effective but more expensive than use of the existing landfarm.	No
	In Situ	Bioventing	Air injection to stimulate biodegradation of fuel residuals. Best if used after the removal of LNAPL. Included as a component of bioslurping.	Yes
		Soil Vapor Extraction	Vapor extraction has been successfully implemented at other sites. Requires expensive off-gas treatment. Included as a component of bioslurping.	No

6.3.1 Alternative 1 - RNA, Bioslurping, and Institutional Controls with Long-Term Groundwater Monitoring

Alternative 1 includes four components: RNA, continued mobile LNAPL recovery through bioslurping, institutional controls, and long-term groundwater monitoring. RNA is proposed to remediate fuel hydrocarbon contaminants dissolved in the groundwater. Ongoing LNAPL recovery through bioslurping will continue to reduce source contaminants, thereby decreasing the expected time frame for remediation. Institutional controls are proposed to ensure that potential receptor exposure pathways are not completed during site remediation. Finally, long-term groundwater monitoring is proposed to demonstrate compliance with remediation objectives.

RNA is achieved when natural attenuation mechanisms bring about a reduction in the total mass of a contaminant in the soil or dissolved in groundwater. RNA results from the integration of several subsurface attenuation mechanisms that are classified as either destructive or nondestructive. Destructive attenuation mechanism include biodegradation, abiotic oxidation, and hydrolysis. Nondestructive attenuation mechanisms include sorption, dilution (caused by dispersion and infiltration), and volatilization. In some cases, RNA will reduce dissolved contaminant concentrations below numerical concentration goals intended to be protective of human health and the environment. As indicated by the evidence of RNA described in Section 4, these processes are occurring at the BX Shoppette and will continue to reduce contaminant mass in the plume area in the shallow and semi-confined aquifers.

In addition to RNA, continued mobile LNAPL recovery through bioslurping has been proposed under Alternative 1 in order to reduce the mass of fuel hydrocarbons available for future dissolution into site groundwater. This would result in a reduction in future dissolved contaminant concentrations, and allow the processes of natural attenuation to complete the remediation of dissolved contamination within a shorter period of time. Bioslurping is a bioremediation technique that is applicable for the remediation and removal of measurable layers of mobile LNAPL on groundwater. A bioslurping system consists of a "slurp" tube that extends through a groundwater monitoring well into the LNAPL layer. Product and highly contaminated groundwater are drawn into the tube as air is removed from the tube with a vacuum extraction pump. Recovery of product is enhanced because a vacuum draws product in the surrounding formation toward the extraction well, rather than relying on gravity flow, as is required with conventional product recovery systems. Furthermore, product flows along a horizontal path toward the bioslurping extraction well. This reduces the "smearing" associated with the groundwater

drawdown created by typical pumping extraction systems. In addition to the removal of LNAPL, as air is removed from the subsurface, oxygenated air is drawn into the pore spaces of the contaminated soils adjacent to the extraction well, promoting aerobic biodegradation (bioventing). Also, contaminated soil vapors are removed by the vacuum (soil vapor extraction). Minimal groundwater is extracted using bioslurping technology, resulting in a significant cost advantage over traditional pumping systems, which generate large quantities of wastewater requiring treatment and disposal.

The effectiveness of bioslurping may exceed a 50 percent/year reduction in mobile LNAPL at the site. Excellent removal rates of LNAPL have already occurred at the site, with an estimated 250 gallons of mobile LNAPL recovered during 2 months of bioslurper operation (Looney, 1996). However, once the majority of mobile LNAPL is extracted, the remaining residual LNAPL will not be effectively remediated with bioslurping. The volume of mobile LNAPL at the site is estimated at 1,200 gallons (Section 4.2). Therefore, recoverable mobile LNAPL may be depleted within the next 6 to 12 months. Eaker AFB anticipates operating the bioslurper at the BX Shoppette until February 1997, and will then reevaluate the usefulness of continued bioslurping operations (Looney, 1996). At this point, low-level residual or mobile source LNAPL will persist for an undetermined length at the site if no additional source reduction is undertaken. However, the groundwater plume is expected to continue shrinking and decreasing in concentration sooner than if RNA were the only remedial option.

Two Bioscreen models were calibrated to site conditions for the shallow aquifer as described in Section 5. The more conservative model calibration, BX1SCAL, assumes a calculated (versus calibrated) BTEX biodegradation rate of 0.0062 day^{-1} and assumes steady-state leaching of BTEX from mobile and residual LNAPL. This model predicts that current site conditions should produce a steady-state groundwater plume that extends a maximum distance of 500 feet downgradient. A steady-state groundwater plume is predicted to be achievable within 6 years from the time that a theoretical, non-depleting LNAPL source is released to the aquifer; therefore, since the first recorded UST leak occurred in 1989 it is likely that groundwater contamination had reached its maximum extent by March 1996. Low detections of BTEX observed in downgradient monitoring points (e.g., 4.0 µg/L BTEX at ESMP-6S and 1.2 µg/L BTEX at ESMP-8S) suggest that the true downgradient extent of the BTEX plume may be approximately 300 feet from the source area. Model BX2SCAL assumes a higher BTEX biodegradation rate of 0.011 day^{-1} (compared to model BX1SCAL) and provides a closer approximation to current site

conditions. Model BX2SCAL predicts that the maximum downgradient extent of BTEX should be approximately 350 feet (the currently observed BTEX plume extends 300 feet). 330 ft.

Six model scenarios for prediction of the contaminant fate and transport in the shallow aquifer where based on the two original shallow aquifer models: three models evaluated source reduction rates of 5 percent/year to 50 percent/year using model BX1SCAL as a base model, and three models used the same source reduction rates with model BX2SCAL as a base model. Modeling suggests that engineered source reduction must occur to complete the remediation of dissolved BTEX through natural attenuation within a reasonable time frame. Assuming an LNAPL removal rate of 5 percent/year (or a BTEX half-life of 14.4 years), the BTEX contamination in the source area will persist for several centuries under current site conditions (models BX1SMODA and BX2SMODA). An observable decrease in the length of the BTEX plume would not occur for at least 10 years. However, this model prediction is considered extremely conservative considering the potential for LNAPL removal through bioslurping.

Given continuing source reduction, actual plume dimensions likely will be smaller than those predicted by the conservative model simulations, with source concentrations falling below target RAOs sooner than predicted. Models BX1SMODC and BX2SMODC assume source reduction rates of 50 percent/year for 14 years and predict that federal MCLs may be achieved throughout the plume within 14 years (2010). This scenario is dependent on continuous reductions in the source area through engineered remediation and/or weathering. If annual source reductions of 50 percent/year are achieved, the length of the BTEX plume will begin to recede noticeably within 6 to 10 years (depending on actual dissolved BTEX biodegradation rates). It is also predicted that continued bioslurping can achieve LNAPL removal rates equaling or exceeding 50 percent/year. However, a 50 percent/year source reduction may be overly optimistic because the best removal rates are typically achieved in the first few years of operation, at which time bioslurping is usually discontinued. On the basis of even the most conservative model, it is unlikely that benzene concentrations exceeding federal MCLs will migrate further than 500 feet downgradient, regardless of source reduction rates. LTM would be used to demonstrate the effectiveness of this remedial alternative.

BTEX concentrations in the deep, semi-confined aquifer also are being reduced under natural attenuation processes. A very conservative model prediction for BTEX contamination in the deep aquifer (BX1DCAL) suggests that BTEX will not migrate farther than a few hundred feet south of the site in the next century. Any BTEX concentrations in the deeper aquifer will decrease as the LNAPL source in the shallow

aquifer is continually reduced. Sporadic detections of low level BTEX contamination in the deep aquifer suggest that potential contamination of this water-bearing unit is minimal. BTEX contamination in the semi-confined aquifer also will be monitored during LTM.

Implementation of Alternative 1 would require the use of institutional controls, such as land use restrictions, and LTM. Land use restrictions may include placing long-term restrictions on soil excavation within the source area and long-term restrictions on groundwater well installation within and downgradient from the source area. The intent of these restrictions would be to reduce potential receptor exposure to contaminants by legally restricting activities within areas affected by site-related contamination.

Public education on the selected alternative would be developed to inform Base personnel and local residents of the scientific principles underlying source reduction and RNA. This education could be accomplished through public meetings, presentations, press releases, and posting of signs where appropriate. Periodic site reviews could also be conducted every year using data collected from the long-term groundwater monitoring program. The purpose of these periodic reviews would be to evaluate the extent of contamination, assess contaminant migration and attenuation through time, document the effectiveness of source removal and institutional controls at the site, and reevaluate the need for additional remedial actions at the site.

6.3.2 Alternative 2 - RNA, Bioslurping, Bioventing, and Institutional Controls with Long-Term Groundwater Monitoring

This alternative is identical to Alternative 1 except that bioslurping operations would be augmented with a bioventing unit to continue reducing the remaining mass of residual LNAPL or lingering mobile LNAPL in soil. The installation of the bioventing unit would conceivably proceed after bioslurper operations had retrieved all reasonably available mobile LNAPL from soil. Bioventing wells would then be installed within and around the perimeter of the source area. By reducing the quantity of residual fuel hydrocarbons within the source area, bioventing would continue to reduce the predicted future dissolution of BTEX into the surficial aquifer, and therefore shorten the predicted length of time required for natural attenuation processes to reduce dissolved BTEX.

Bioventing is an *in situ* bioremediation technique that is applicable for the remediation of fuel hydrocarbon compounds in vadose zone soils. At this site, regenerative blower would be used to inject air at a low flow rate into vertical injection wells screened where contamination is present within vadose zone soils. Alternately, a vacuum extraction

pump can be used to withdraw air from the wells. This process promotes aerobic biodegradation of fuel constituents through the introduction of oxygenated air into contaminated soils.

As previously discussed in Section 6.3.1, models BX1SMODC and BX2SMODC predict that substantial rates of source reduction (i.e., on the order of 50 percent/year) as would be expected with a bioslurping/bioventing operations may reduce the groundwater plume to below federal MCLs within 14 years. An observable decrease in the length of the BTEX plume may be expected within 6 to 10 years. Achieving these source reduction rates would be more plausible than with bioslurping alone.

BTEX removal rates from other sites with similar contaminants and fully penetrating contaminant columns in the vadose zone have exceeded 90-percent BTEX removal per year (Miller *et al.*, 1993). If source reduction rates exceeded 50 percent/year, then the BTEX plume would be remediated in less than 14 years. However, results from pilot studies may be necessary to design a full-scale bioventing system capable of remediating residual LNAPL. Pilot-scale bioventing systems are currently operating at other Eaker AFB sites under a separate AFCEE program. Preliminary results from these pilot tests at the Building 457 UST and Site 410 suggest that bioventing is effective in soil types similar to those found at the BX Shoppette. Therefore, a bioventing pilot test may not be necessary at the BX Shoppette to size a full-scale bioventing system considering the current bioventing operations at other Eaker AFB sites.

As with Alternative 1, institutional controls and LTM would be required. However, due to the shorter time frame, annual groundwater monitoring would ~~not~~ be required for 15 years, instead of 20 years for Alternative 1.

6.3.3 Alternative 3 - RNA, Soil Excavation, Bioslurping, and Institutional Controls with Long-Term Groundwater Monitoring

This alternative is similar to Alternative 2 except that soil excavation would be used to remove the majority of the residual or mobile LNAPL. Excavation would be implemented either prior to the completion of bioslurping operations or after bioslurping operations. A bioventing unit would not be installed under this alternative. Removal of LNAPL-contaminated soil could be accomplished rapidly by excavation to remove the remaining contaminant source. An estimated 1,700 cubic yards (cy) of contaminated soil (and 1,850 cy of backfill) would require removal. Excavated soil likely could be treated in the Base landfarming operation, which is permitted by the state.

As with Alternatives 1 and 2, institutional controls and LTM would be required. However, due to the shorter time frame, annual groundwater monitoring would not be required for as many years.

6.4 EVALUATION OF ALTERNATIVES

This section provides a comparative analysis based on the effectiveness, implementability and cost criteria for the three previously discussed remedial alternatives. A summary of this evaluation is presented in Section 6.5.

6.4.1 Alternative 1 - RNA, Bioslurping, and Institutional Controls with Long-Term Groundwater Monitoring

6.4.1.1 Effectiveness

Section 5 of this document presents the results of the Bioscreen models completed to evaluate the RNA alternative at the former BX Shoppette. Model results predicted that under the most conservative of site conditions, RNA will limit BTEX migration to within 500 feet of the source area and slowly reduce contaminant mass and toxicity. Potential exposure pathways (i.e., downgradient potable water wells) are not likely to be completed. Groundwater monitoring will allow for continued evaluation of BTEX migration and ensure the continued effectiveness of this alternative. The drainage canal located north/northeast overlaps the periphery of the groundwater BTEX plume; therefore, significant concentrations of BTEX contamination are not expected to discharge to the canal. This hypothesis is supported by the fact that BTEX concentrations have not been detected in the canal along suspected sections of site groundwater underflow. Furthermore, the federal ambient water quality criteria presented in Table 6.1 suggest any BTEX contamination reaching the canal would have to occur at extremely elevated concentrations to pose a hazard to human health or the environment. In the event that migration of BTEX compounds exceed predictions, this alternative does not cease to be protective; however, the alternative should be reevaluated.

Initial mobile LNAPL removal rates exceeding 125 gallons per month (Looney, 1996) suggest that bioslurper operations at the BX Shoppette are effectively removing mobile LNAPL. In addition, the bioslurping system is extracting a layer of the shallowest groundwater and soil vapor within the source area. Because of its close proximity to LNAPL, this groundwater would be expected to have very high concentrations of dissolved fuel hydrocarbons; therefore, it is the ideal groundwater to target for extraction from the aquifer system. The removal and treatment of soil vapor is analogous to soil

vapor extraction. Fortuitously, the same vapor extraction process promotes *in situ* contaminant biodegradation by drawing uncontaminated soil vapor through contaminated soils.

The effectiveness of this remedial alternative requires that excavations or drilling within the source area be conducted only by properly protected site workers. Reasonable land use assumptions for the plume area indicate that exposure is unlikely unless excavation or drilling activities bring contaminated soil to the surface. Existing health and safety plans should be enforced to reduce risks from any proposed remediation systems and during installation of additional sentry and LTM wells. Long-term land use restrictions would be required to ensure that shallow groundwater will not be pumped or removed for potable use within, and approximately 500 feet in all directions from, the existing BTEX plume.

Compliance with AFCEE program goals is one component of the long-term effectiveness evaluation criterion. Alternative 1 will satisfy program objectives designed to promote RNA as a component of site remediation and to scientifically document natural attenuation processes. Alternative 1 is based on the effectiveness of natural processes that minimize contaminant migration and reduce contaminant mass over time, and the effectiveness of institutional controls. Bioscreen model results suggest that BTEX plume migration will be naturally attenuated within 500 feet of the source area (BTEX below 1 μg/L).

Apart from the administrative concerns associated with enforcement of long-term land use restrictions and long-term groundwater monitoring programs, this remedial alternative should provide reliable, cost-effective protection. For cost comparison purposes, it is assumed that bioslurping will be performed for a period of 1 year. At that time, most mobile LNAPL will likely be removed from all site monitoring wells. Limited aerobic biodegradation of the residual LNAPL biodegradation should also be increased during bioslurping operations as vadose soils are replenished with atmospheric oxygen through the vacuum effects of bioslurping. After bioslurping operations are terminated, residual LNAPL will act as a BTEX source to groundwater until completely degraded through weathering.

For costing purposes, Parsons ES assumed that LTM will continue for a 20-year period. Although the most favorable of model scenarios predict that LNAPL in the source area will remain for 14 years (50 percent per year loss of LNAPL), actual removal rates of mobile and residual LNAPL through bioslurping operations may exceed this

assumed removal rate within the first year of operation, but decrease to less than this rate is subsequent years. The 20-year time frame assumes that residual and mobile LNAPL removal will continue through 1 year of bioslurping and 19 years of continued source weathering and dissolved BTEX remediation. During these 20 years, dissolved benzene concentrations within the interior of the BTEX plume in the shallow aquifer should decrease below federal MCLs. BTEX concentrations in the deeper semi-confined aquifer at POC wells are predicted to be nondetectable.

6.4.1.2 Implementability

Alternative 1 is not technically difficult to implement. A bioslurper is currently being used to remove mobile LNAPL from monitoring wells TW-1105 and TW-1108 at the former BX Shoppette. These two monitoring wells contained the only measurable mobile LNAPL in March 1996. Initial LNAPL recovery rates are favorable (>250 gallons of mobile LNAPL recovered in the first 2 months of operation) and suggest that substantial remediation of the source area will be achieved. Bioslurper operations are predicted to continue for at least the next 6 to 12 months (Looney, 1996).

Installation of monitoring wells and annual groundwater monitoring are standard procedures. Long-term management efforts will be required to ensure that proper sampling procedures are followed. Periodic site reviews should be conducted to confirm the adequacy and completeness of LTM data and to verify the effectiveness of this remediation approach. There also may be administrative concerns associated with long-term enforcement of groundwater use restrictions. Future land use within the source area may be impacted by leaving contaminated soil and groundwater in place. Regulators, Base officials, Base employees, and the public would have to be informed of the benefits and limitations of the RNA option. Educational programs are not difficult to implement, and the initial regulatory reaction to this alternative has been positive.

6.4.1.3 Cost

The cost of Alternative 1 is summarized in Table 6.3. A more complete breakdown and present worth analysis of these costs is provided in Appendix F. Capital costs include the construction of five new LTM wells. The total present worth cost of mobile LNAPL recovery from continued bioslurping for a period of 1 year and implementation of the LTM plan for 20 years is approximately $317,000. Bioslurping costs are accounted for under a separate AFCEE contract and are not reflected in the cost estimate

TABLE 6.3
ALTERNATIVE 1 - COST ESTIMATE
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Capital Costs	Cost
Design/Construct 5 LTM Wells	$13,500
Annual Monitoring Costs (20 years)	**Cost per Event**
Conduct Annual Sampling at 11 LTM and 3 surface water locations	$11,060
Maintain Institutional Controls/Public Education	$5,000
Project Management and Reporting	$10,700
Present Worth of Alternative 1 [a/]	**$317,000**

[a/] Based on an annual adjustment factor of 7 percent (USEPA, 1993).

for Alternative 1. Also included are the costs of maintaining institutional controls and long-term groundwater monitoring for a total of 20 years.

6.4.2 Alternative 2 - RNA, Bioslurping/Bioventing, and Institutional Controls with Long-Term Groundwater Monitoring

6.4.2.1 Effectiveness

The effectiveness of the RNA, bioslurping, institutional controls, and LTM components of this alternative were described under Alternative 1. Bioslurping is an effective technology for removing mobile LNAPL while simultaneously enhancing biodegradation by subsurface aeration. Traditional bioventing involves the injection of air into a vent well (often a converted monitoring well) to achieve oxygenation of the subsurface. The goal of a bioventing system under Alternative 2 would be to biodegrade residual LNAPL from the source area that may not be remediated through bioslurping, and thereby promote RNA of dissolved contaminants in the groundwater through a further decreased infusion of additional contaminants.

The monitoring wells used in the extraction of mobile LNAPL (TW-1105 and TW-1108) with the bioslurper have screened intervals that extend a few feet above the water

table. Therefore, these wells could be converted for air injection following completion of bioslurping. However, additional bioventing wells would need to be installed in the source area to optimize the effective treatment zone. Model results suggest that increased reduction of contaminant mass in source area soils would enhance the effectiveness of RNA and expedite plume reduction.

Alternative 2 is not difficult to implement should provide reliable, continuous protection with little risk from temporary system failures. This alternative is based on the effectiveness of the current bioslurping and a future bioventing system in removing mobile and residual LNAPL from the site, preferably within 4 years. Once BTEX leaching rates are reduced, RNA will then minimize contaminant migration and reduce contaminant mass in groundwater. This alternative also complies with AFCEE program goals because RNA remains the predominant remediation method for fuel hydrocarbons dissolved in groundwater at the site. This remedial alternative, however, will result in the generation of drill cuttings, LNAPL, contaminated water, and soil gas, all which may require treatment and/or disposal.

6.4.2.2 Implementability

Alternative 2 is not difficult to implement. Residual LNAPL removal would be conducted through bioventing at the former BX Shoppette from wells that would be installed in source area soils that are oxygen deficient. The bioventing system would consist of a series of air injection wells connected to a small blower by underground piping. This equipment is fairly common within the environmental industry. Periodic maintenance would be required for the regenerative blower, and weekly system checks are recommended to record operating data such as injection pressures and flow rates. A bioventing pilot test is not included within the cost estimate for this alternative for a full-scale system design. Instead, Initial bioventing pilot test results at two other Eaker AFB locations (Building 457 UST and Site 410) would be used to obtain the necessary parameters for bioventing system design at the BX Shoppette. The technical and administrative implementability concerns associated with the RNA and LTM components of this remedial alternative are similar to those discussed in Alternative 1.

6.4.2.3 Cost

The estimated capital and operating costs of Alternative 2 are summarized in Table 6.4. A more complete breakdown and a present-worth analysis of these costs are provided in Appendix F. Capital costs are the same for construction of five new LTM

wells, as in Alternative 1. In addition, Alternative 2 includes costs for the 6 bioventing wells and a bioventing blower. It is assumed that the bioventing system would begin operation after 1 year of bioslurping operations (fall 1997) and would operate for a total of 3 years after installation. The increase in source removal rates over a bioslurping operation alone (as in Alternative 1) will decrease the time required for LTM to 15 years. The overall present worth cost for 1 year of continued bioslurping, installation of the bioventing system after bioslurping, operation of the bioventing system, and implementation of the LTM plan is estimated to be approximately $399,000. Also included are the costs of maintaining institutional controls and long-term groundwater monitoring for a total of 15 years.

6.4.3 Alternative 3 - RNA, Soil Excavation, Bioslurping, and Institutional Controls with Long-Term Groundwater Monitoring

6.4.3.1 Effectiveness

The effectiveness of the RNA, bioslurping, institutional controls, and LTM components of this alternative were described under Alternatives 1 and 2. Soil excavation is an established technology for reducing source contamination and controlling plume migration. Soil excavation would instantaneously eliminate the majority of the continuing source for dissolved BTEX in the groundwater. Low levels of mobile and residual LNAPL contamination would be expected to remain below the water table, at the capillary fringe, and at the periphery of the excavation. Natural weathering is expected to continue reducing LNAPL levels after excavation. Predicting the effects on plume migration after source excavation and subsequent weathering is beyond the capabilities of the Bioscreen model. However, source reduction rates are suspected to equal or exceed those rates potentially achieved through bioslurping/bioventing (Alternative 2). Therefore, it is likely that excavation of the source area and subsequent weathering will lead to complete BTEX plume remediation within the next 10 to 15 years.

Alternative 3 should provide reliable, continuous protection. This alternative, however, does not fully attain AFCEE program goals because of the generation of soil waste. However, the excavated soil would be remediated in the Base landfarming operation, which relies extensively on biological processes to remediate fuel hydrocarbon contamination. Also, RNA remains the principal mechanism for remediating the dissolved fuel hydrocarbon concentrations in site groundwater.

TABLE 6.4
ALTERNATIVE 2 - COST ESTIMATE
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Capital Costs	**Cost**
Design/Construct 5 LTM Wells	$13,500
Bioventing System Installation	$74,000
Annual Monitoring Costs (15 years)	**Cost per Event**
Conduct Sampling at 11 LTM and 3 surface water locations	$11,000
Maintain Institutional Controls/Public Education	$5,000
Project Management and Reporting	$10,700
Bioventing Costs (years 2 through 4)	
System Maintenance	$16,000
Reporting Costs	$4,300
Present Worth of Alternative 2 [a/]	**$399,000**

[a/] Based on an annual adjustment factor of 7 percent (USEPA, 1993).

6.4.3.2 Implementability

Alternative 3 would minimally disrupt Base activities because the Base is closed. Excavation would commence prior to discontinuing bioslurping operations within the next 6 to 12 months. Mobile and residual LNAPL would be physically removed by excavating soil to a depth of approximately 9 feet in the source areas surrounding TW-1105 and TW-1111. The areas would then be backfilled with clean native soil or treated soils from the adjacent soil landfarm. Because Eaker AFB operates a state-permitted landfarm on Base, it is assumed that contaminated soil would be treated at this facility. The technical and administrative implementability concerns associated with the bioslurping, RNA, LTM, and institutional control components of this remedial alternative are similar to those discussed for the previous two alternatives. However, two existing wells proposed for LTM (monitoring wells TW-1105 and TW-1111) in the source areas

would be destroyed during source excavation. These wells would be replaced after to excavation complete the LTM well plan described in Section 7.

6.4.3.3 Cost

The cost of Alternative 3 is summarized in Table 6.5. A more complete breakdown and present worth analysis of these costs are provided in Appendix F. The total present worth cost of Alternative 3 is approximately $340,000. The cost of Alternative 3 varies from the cost of Alternative 1 by the addition of excavation, treatment, and replacement of approximately 1,700 cubic yards of contaminated soil. For cost-comparison purposes, it was assumed that the bioslurping system would continue to operate for 1 year before excavation. Also included are the costs of maintaining institutional controls and long-term groundwater monitoring for a total of 15 years.

6.5 RECOMMENDED REMEDIAL APPROACH

Three remedial alternatives were evaluated for remediation of the shallow groundwater at the former BX Shoppette. Components of the alternatives evaluated include mobile LNAPL recovery, bioslurping, bioventing, soil excavation, RNA, LTM, and institutional controls. Tables 6.2, 6.3, 6.4, and 6.5 summarize the results of the evaluation based upon effectiveness, implementability, and cost criteria. Based on this evaluation, the Air Force recommends Alternative 3 as achieving the best combination of risk reduction, implementability, and cost effectiveness.

All three alternatives rely on natural attenuation processes to reduce migration and toxicity of the dissolved BTEX plume. All three also help limit further BTEX plume migration by reducing the magnitude of continuing sources. Implementation of Alternative 1 is estimated to achieve BTEX remediation within 20 years. Implementation of Alternative 2 or 3 is estimated to achieve BTEX remediation within 15 years. The bioslurping/bioventing components of Alternatives 1 and 2 require periodic monitoring and maintenance, while the soil excavation component of Alternative 3 would generate a significant volume of waste soil that would require treatment.

The final evaluation criterion used to compare each of the three remedial alternatives was present worth cost. Because the Base is being closed, it is the opinion of the Air Force that the slight additional cost of Alternative 3 over Alternative 1 is justified by the reduction in the estimated cleanup time. Furthermore, Alternative 3 is expected to achieve cleanup at least as fast and at a lower cost than Alternative 2. Although Alternative 3 does not comply with the AFCEE goal for the minimization of generated

TABLE 6.5
ALTERNATIVE 3 - COST ESTIMATE
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Capital Costs	**Cost**
Design/Construct 7 LTM Wells	$15,000
Excavation (Excavation, Transport, Disposal, and Backfill)	$29,900
Annual Monitoring Costs (15 years)	**Cost per Event**
Conduct Sampling at 11 LTM and 3 Surface Water Locations	$11,000
Maintain Institutional Controls/Public Education	$5,000
Project Management and Reporting	$10,700
Excavation Costs (3 years)	
Annual Tilling/Sampling	$18,500
Reporting Costs	$6,500
Clearance Sampling (Single Event at End of Annual Sampling)	$5,800
Present Worth of Alternative 3 [a/]	**$340,000**

[a/] Based on an annual adjustment factor of 7 percent (USEPA, 1993).

waste, it is expected to achieve the most rapid remediation of dissolved BTEX concentrations and has the convenience of utilizing an on-Base landfarm to minimize cost, transportation, and disposal requirements. Implementation of Alternative 3 would require land use and groundwater use controls to be enforced for approximately 15 years (possibly less depending on the potential for RNA) beyond the startup date of bioslurping operations (September 1996), along with annual groundwater monitoring in the shallow and deep aquifers for up to 15 years.

SECTION 7

LONG-TERM MONITORING PLAN

7.1 OVERVIEW

In keeping with the requirements of the preferred remedial alternative for the former BX Shoppette (LNAPL recovery, soil excavation, and RNA with LTM), a long-term groundwater monitoring plan was developed. The purpose of this component of the preferred remedial alternative for the site is to assess conditions over time, confirm the effectiveness of LNAPL recovery/removal and natural processes at reducing dissolved contaminant mass and minimizing contaminant migration, assess compliance with regulatory cleanup goals, and evaluate the need for additional remediation.

To demonstrate attainment of site-specific remediation goals and to verify the predictions of the Bioscreen models developed for the former BX Shoppette, the LTM plan consists of identifying the location of two separate groundwater monitoring networks and developing a groundwater sampling and analysis strategy. The strategy described in this section is designed to monitor plume migration in the shallow and semi-confined aquifer over time, to verify that RNA (as augmented with source reduction technologies) is occurring at rates sufficient to protect potential receptors, and to meet federal regulatory requirements. In the event that data collected under this LTM program indicate that the selected remedial alternative is insufficient to protect human health and the environment, contingency controls to augment the beneficial effects of RNA Would be necessary.

7.2 MONITORING NETWORKS

Two separate sets of wells will be used at the site as part of remedial Alternative 1. The first set will consist of LTM wells located within the observed BTEX plume to verify the results of the Bioscreen modeling effort and to ensure that natural attenuation is occurring at rates sufficient to minimize plume expansion (i.e., meet the first level of RAOs for the site). This network of wells will consist of four existing and two proposed monitoring wells screened within the shallow aquifer to provide confirmation and verification of the quantitative groundwater modeling results.

The second set of groundwater monitoring wells are sentry wells that will be located downgradient from the source area in the shallow and deep aquifers. The purpose of the

sentry wells is to verify that no BTEX compounds exceeding federal MCLs migrate to areas outside of institutional control where groundwater may affect potential receptors (i.e., meet the second level of RAOs for the site). This network will consist of three sentry monitoring wells screened across the shallow aquifer and two sentry monitoring wells screened in the deep aquifer.

7.2.1 Long-Term Monitoring Wells

Two proposed and four existing groundwater wells/points will be used to monitor the effectiveness of RNA in reducing total contaminant mass and minimizing contaminant migration at the former BX Shoppette. Proposed monitoring wells to be placed near the former locations of monitoring wells TW-1105 and TW-1111 [assumed to be removed during soil excavation activities to be implemented under Alternative 3 (Section 6)] will be used to monitor conditions in the plume source area. Monitoring wells TW-1110 and MW-1104 will be used to evaluate groundwater conditions along the apparent migration pathway to the southeast, and monitoring points ESMP-6S and ESMP-8S will be used to monitor groundwater conditions near the extent of the apparent southeasterly flow direction. Figure 7.1 identifies the locations of groundwater monitoring points proposed for LTM. This network will supplement the sentry and sentry wells to provide early confirmation of model predictions and to allow additional response time if necessary.

7.2.2 Sentry Wells

Three proposed sentry wells will be used for monitoring groundwater conditions in the shallow aquifer downgradient from the source area at the former BX Shoppette (Figure 7.1). One proposed sentry well will be located approximately 500 feet to the southeast of the southern source area located at TW-1105. Another proposed sentry well will be similarly placed approximately 500 feet to the southeast of the northern source area located at TW-1111. To ensure that BTEX concentrations are not migrating away from the site to the northwest during periods of fluctuating groundwater conditions, a third sentry well will be located northwest of the source areas (approximately 30 feet northwest of monitoring well MW-1120). Figure 7.1 shows the proposed locations of the sentry wells for the shallow aquifer.

Two proposed sentry wells will be used for the deeper, sand aquifer. One proposed sentry well will be located approximately 30 feet northwest of monitoring well MW-1120 (near the sentry well for the shallow aquifer). The proposed sentry well will be located southwest of monitoring well MW-1116 to ensure protection of downgradient receptors

along the direction of observed groundwater flow to the southwest. Figure 7.1 shows the proposed locations of the sentry wells for the deeper aquifer.

The purpose of the sentry wells is to provide information on the direction of plume migration from the source areas and to verify that no contaminated groundwater exceeding federal MCLs migrates beyond the area under institutional control. Although model results suggest that the BTEX plume will not migrate more than 500 feet in any direction of the source area in the shallow aquifer and 200 feet within the deep aquifer (within the next century), these sentry wells are the technical mechanisms used to demonstrate protection of human health and the environment and compliance with site-specific numerical remediation goals.

As with the LTM wells in the shallow aquifer, the sentry wells in the shallow aquifer will be screened in the same hydrogeologic unit as the contaminant plume. Data presented in this report concerning the nature and extent of contamination at the site suggest that a 10-foot screen with approximately 5 feet of screen below the groundwater surface of the shallow aquifer will be sufficient to intercept the contaminant plume at this site. Sentry wells in the deeper aquifer also will be screened with 10-foot screen intervals, with the top of the screen placed near the bottom surface of the clay layer separating the surface aquifer from the deeper aquifer.

7.3 SURFACE WATER SAMPLING LOCATIONS

In order to assess the potential future impact of groundwater discharge, surface water samples will be collected along the drainage canal north/northeast of the BX Shoppette. Trends in analytical results from these samples will be used to evaluate the impact of groundwater discharge on the quality of the surface water, and the effects of natural attenuation on contaminant concentrations (if any) in the drainage canal.

Surface water samples will be collected at three locations along the northwest/southeast flowing canal, as illustrated on Figure 7.1. These sampling locations have been selected to assess surface water quality upstream from, within, and immediately downstream from a potential plume discharge area.

7.4 GROUNDWATER/SURFACE WATER SAMPLING

To ensure that sufficient contaminant removal is occurring at the former BX Shoppette to meet site-specific remediation goals, this long-term groundwater monitoring plan includes a general sampling and analysis plan (SAP). LTM wells, sentry wells, and surface water will be sampled and analyzed annually to document plume migration and to

verify that natural processes are effectively reducing contaminant mass and mobility. Reduction in toxicity will be implied by mass reduction. The SAP also is aimed at assuring that the selected remedial alternative can achieve site-specific remediation concentration goals for BTEX compounds.

7.4.1 Analytical Protocol

All LTM and sentry wells in the LTM program will be sampled and analyzed to determine compliance with chemical-specific federal MCLs to verify the effectiveness of RNA at the site. Water level measurements will be made at all LTM and sentry wells during each sampling event. Groundwater samples collected for LTM wells will be analyzed for the parameters listed in Table 7.1. Groundwater samples collected for sentry wells will be analyzed for the parameters listed in Table 7.2. A more detailed site-specific groundwater SAP should be prepared prior to initiating the LTM program.

Surface water samples will be collected and analyzed to verify that RNA is reducing BTEX concentrations in groundwater before potential impact on the adjacent drainage canal. Surface water samples will be analyzed for the parameters listed in Table 7.3.

7.4.2 Sampling Frequency

Each LTM, sentry, and surface water location will be sampled once each year for 15 years. If the data collected during this time period support the anticipated effectiveness of RNA at this site, the sampling frequency can be reduced to once every 5 years for all wells in the LTM program, or eliminated. If the data collected at any time during the monitoring period indicate the need for additional remedial activities at the site, sampling frequency should be adjusted accordingly.

TABLE 7.1
GROUNDWATER MONITORING ANALYTICAL PROTOCOL FOR LONG-TERM MONITORING WELLS
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Ferrous Iron (Fe^{2+})	Colorimetric A3500-Fe D	Field only	Elevated ferrous iron concentrations may be indicative of the anaerobic biodegradation process of iron reduction.	Annually for 15 Years	Collect 100 mL of water in a glass container; acidify with hydrochloric acid per method	Field
Ferrous Iron (Fe^{2+})	Colorimetric Hach® 25140-25	Alternate method; field only	Same as above.	Annually for 15 Years	Collect 100 mL of water in a glass container	Field
Temperature	E170.1	Field only	Metabolism rates for microorganisms depend on temperature.	Annually for 15 Years	N/A	Field
Dissolved Oxygen	Dissolved oxygen meter	Refer to Method A4500 for a comparable laboratory procedure	The oxygen concentration is a data input to the Bioplume II model; concentrations less than 1 mg/L generally indicate an anaerobic pathway.	Annually for 15 Years	Collect 300 mL of water in biochemical oxygen demand bottles; analyze immediately; alternately, measure dissolved oxygen in situ	Field
pH	E150.1/SW9040, direct reading meter	Protocols/Handbook methods[a/]	Aerobic and anaerobic processes are pH-sensitive.	Annually for 15 Years	Collect 100–250 mL of water in a glass or plastic container; analyze immediately	Field
Conductivity	E120.1/SW9050, direct reading meter	Protocols/Handbook methods	General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system.	Annually for 15 Years	Collect 100–250 mL of water in a glass or plastic container	Field
Nitrate	IC method E300 or Hach® Nitraver 5 method	Method E300 is a Handbook method. Hach® method is photometric	Substrate for microbial respiration if oxygen is depleted.	Annually for 15 Years	Collect up to 40 mL of water in a glass or plastic container; cool to 4°C	Fixed-base or field (for Hach® method)

TABLE 7.1 (Concluded)
GROUNDWATER MONITORING ANALYTICAL PROTOCOL FOR LONG-TERM MONITORING WELLS
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Sulfate (SO_4^{2-})	IC method E300 or method SW9056 or Hach® SulfaVer 4 method	Method E300 is a Handbook method; method SW9056 is an equivalent procedure. Hach® method is Photometric.	Substrate for anaerobic microbial respiration.	Annually for 15 Years	Collect up to 40 mL of water in a glass or plastic container; cool to 4°C.	Fixed-base or field (for Hach® method)
Redox potential	A2580 B	Measurements are made with electrodes; results are displayed on a meter; samples should be protected from exposure to atmospheric oxygen	The redox potential of groundwater influences and is influenced by biologically mediated reactions; the redox potential of groundwater may range from more than 200 mV to less than -400 mV.	Annually for 15 Years	Collect 100–250 mL of water in a glass container, filling container from bottom; analyze immediately	Field
Methane, ethane, ethene	RSKSOP-114 modified to analyze water samples for methane by headspace sampling with dual thermal conductivity and flame ionization detection.	Method published and used by the USEPA National Risk Management Research Laboratory.	The presence of methane suggests BTEX degradation via an anaerobic pathway utilizing carbon dioxide (carbonate) as the electron acceptor (methanogenesis).	Annually for 15 Years	Collect water samples in 40 mL volatile organic analysis (VOA) vials with butyl gray/Teflon-lined caps (zero headspace); cool to 4°C.	Fixed-base
Aromatic hydrocarbons (BTEX)	Purge and trap GC method SW8020 or GC/MS method SW8260.	Handbook method; analysis may be extended to higher molecular weight alkylbenzenes	BTEX are the primary target analytes for monitoring natural attenuation; BTEX concentrations must also be measured for regulatory compliance.	Annually for 15 Years	Collect water samples in a 40 mL VOA vial with zero headspace; cool to 4°C; add hydrochloric acid to pH ≤2	Fixed-base

a/ Protocol analytical methods are those presented by Wiedemeier *et al.* (1995). Handbook refers to "AFCEE Handbook to Support the Installation Restoration Program (IRP) Remedial Investigation/Feasibility Study (RI/FS).

TABLE 7.2
GROUNDWATER MONITORING ANALYTICAL PROTOCOL FOR SENTRY WELLS
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Temperature	E170.1	Field only	Metabolism rates for microorganisms depend on temperature.	Annually for 15 Years	N/A	Field
Dissolved Oxygen	Dissolved oxygen meter	Refer to Method A4500 for a comparable laboratory procedure	The oxygen concentration is a data input to the Bioplume II model; concentrations less than 1 mg/L generally indicate an anaerobic pathway.	Annually for 15 Years	Collect 300 mL of water in biochemical oxygen demand bottles; analyze immediately; alternately, measure dissolved oxygen in situ	Field
pH	E150.1/SW9040, direct reading meter	Protocols/Handbook methods[a/]	Aerobic and anaerobic processes are pH-sensitive.	Annually for 15 Years	Collect 100–250 mL of water in a glass or plastic container; analyze immediately	Field
Redox potential	A2580 B	Measurements are made with electrodes; results are displayed on a meter; samples should be protected from exposure to atmospheric oxygen	The redox potential of groundwater influences and is influenced by biologically mediated reactions; the redox potential of groundwater may range from more than 200 mV to less than -400 mV.	Annually for 15 Years	Collect 100–250 mL of water in a glass container, filling container from bottom; analyze immediately	Field
Aromatic hydrocarbons (BTEX)	Purge and trap GC method SW8020 or GC/MS method SW8260.	Handbook method; analysis may be extended to higher molecular weight alkylbenzenes	BTEX are the primary target analytes for monitoring natural attenuation; BTEX concentrations must also be measured for regulatory compliance.	Annually for 15 Years	Collect water samples in a 40 mL VOA vial with zero headspace; cool to 4°C; add hydrochloric acid to pH ≤2	Fixed-base
Conductivity	E120.1/SW9050, direct reading meter	Protocols/Handbook methods	General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system.	Annually for 15 Years	Collect 100–250 mL of water in a glass or plastic container	Field

a/ Protocol analytical methods are those presented by Wiedemeier *et al.* (1995). Handbook refers to "AFCEE Handbook to Support the Installation Restoration Program (IRP) Remedial Investigation/Feasibility Study (RI/FS).

TABLE 7.3
MONITORING ANALYTICAL PROTOCOL FOR SURFACE WATER SAMPLES
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Dissolved Oxygen	Dissolved oxygen meter	Refer to Method A4500 for a comparable laboratory procedure	The oxygen concentration is a data input to the Bioplume II model; concentrations less than 1 mg/L generally indicate an anaerobic pathway.	Annually for 15 Years	Collect 300 mL of water in biochemical oxygen demand bottles; analyze immediately; alternately, measure dissolved oxygen in situ	Field
pH	E150.1/SW9040, direct reading meter	Protocols/Handbook methods[a/]	Aerobic and anaerobic processes are pH-sensitive.	Annually for 15 Years	Collect 100–250 mL of water in a glass or plastic container; analyze immediately	Field
Conductivity	E120.1/SW9050, direct reading meter	Protocols/Handbook methods	General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system.	Annually for 15 Years	Collect 100–250 mL of water in a glass or plastic container	Field
TOC	SW9060	USEPA Test Method[b/]	TOC often used in regulatory compliance to monitor the impacts of organics compounds on surface water quality	Annually for 15 Years	Collect 500 mL of water in a glass or plastic container. Cool to 4°C; add hydrochloric or sulfuric acid to pH ≤2	
Aromatic hydrocarbons (BTEX)	Purge and trap GC method SW8020 or GC/MS method SW8260	Handbook method; analysis may be extended to higher molecular weight alkylbenzenes	BTEX are the primary target analytes for monitoring impacts of groundwater discharging into surface water; BTEX concentrations must also be measured for regulatory compliance.	Annually for 15 Years	Collect water samples in a 40 mL VOA vial with zero headspace; cool to 4°C; add hydrochloric acid to pH ≤2	Fixed-base

a/ Protocol analytical methods are those presented by Wiedemeier *et al.* (1995). Handbook refers to "AFCEE Handbook to Support the Installation Restoration Program (IRP) Remedial Investigation/Feasibility Study (RI/FS). Test Method refers to "Test Methods For Evaluating Solid Waste (EPA, 1995).

SECTION 8

CONCLUSIONS AND RECOMMENDATIONS

This report presents the results of a TS conducted to evaluate the use of RNA of fuel-hydrocarbon-contaminated groundwater at the former BX Shoppette, Eaker AFB, Arkansas. Specifically, the Domenico (1987) analytical solute transport model Bioscreen was used in conjunction with site-specific geologic, hydrologic, and laboratory analytical data to simulate the migration and biodegradation of fuel hydrocarbon compounds dissolved in groundwater. Groundwater contaminant and geochemical data strongly suggest that aerobic biodegradation of fuel hydrocarbons is occurring at the site. In addition, the data also suggest that anaerobic biodegradation is occurring via manganese reduction, sulfate reduction, methanogenesis, and iron reduction.

To collect the data necessary for the RNA demonstration, Parsons ES collected and analyzed soil, groundwater, surface water, and sediment samples from the site. Site-specific geologic, hydrologic, and laboratory analytical data were then used in the Bioscreen analytical groundwater model to simulate the effects of advection, dispersion, sorption, and biodegradation on the fate and transport of the dissolved BTEX plume. Extensive site-specific data were used for model implementation. Model parameters that could not be obtained from existing site data were estimated using widely accepted literature values for aquifer materials similar to those found at the site. Conservative aquifer parameters were used to construct the Bioscreen models for this study. Therefore, the model results presented herein represent conservative predictions of groundwater BTEX plume migration.

Two model calibrations were performed for the BX Shoppette to provide a range of model predictions given the variability of site conditions. For calibrated model BX1SCAL, it was assumed that source conditions observed in March 1996 remained at steady-state, and the dissolved BTEX biodegradation rate was maintained at 0.0062 day^{-1} [calculated by the method of Buscheck and Alcantar (1995)]. Calibrated model BX2SCAL was identical to model BX1SCAL with the exception that the dissolved BTEX biodegradation rate was increased to 0.011 day^{-1} through a trial-and-error process to provide a better match between modeled and observed BTEX plume concentrations and dimensions.

On the basis of the two models calibrated to site conditions, six different model scenarios were run to evaluate plume characteristics when influenced by different source removal rates. Models BX1SMODA through BX1SMODC were based on calibrated model BX1SCAL and simulated source removal rates of 5, 20, and 50 percent per year. Models BX2SMODA through BX2SMODC were based on calibrated model BX2SCAL and also simulated source removal rates of 5, 20, and 50 percent per year, respectively for the shallow aquifer. The time required for BTEX remediation in the six model scenarios was predicted to range between 14 and 200 years. Under any model scenario, the BTEX plume is not predicted to begin noticeable shrinkage for at least 6 years. However, calibrated model BX1SCAL predicts that the leading edge of the BTEX plume in the

shallow aquifer will not migrate farther than 500 feet downgradient of the source area. Model BX1SCAL was assumed to be the most conservative model scenario because it assumes a steady-state source term.

The results of this study suggest that natural attenuation of BTEX compounds is occurring at the BX Shoppette to the extent that the dissolved concentrations of these compounds in groundwater should be reduced to levels below current regulatory standards long before potential downgradient receptors could be adversely affected (i.e., the potential contaminant migration pathway will not be complete at potential receptor exposure points described in Section 6.2). Although the drainage canal may potentially receive groundwater contamination during groundwater table fluctuations, BTEX contamination has not previously been detected in the drainage canal at a point of discharge. Furthermore, the closest on-Base potable water well is located approximately 4,200 feet southwest of the BX Shoppette and is screened 1,300 feet bgs in the Wilcox Formation.

Based on the minimal potential for exposure to downgradient receptors, the rates of BTEX plume migration and degradation predicted by model BX1SCAL, and the cost effectiveness of Alternative 3 as compared to the other remedial alternatives (on a present-worth basis), the Air Force recommends continued operation of the bioslurper until soil excavation in the source area can be initiated. Source excavation will be coupled with RNA, institutional controls, and LTM as the remedial option for the former BX Shoppette site.

To accomplish the recommended alternative, construction activities and groundwater use in and downgradient from the source area should be restricted for a period of approximately 15 years or until groundwater contaminant concentrations decrease below federal MCLs for BTEX. Groundwater and surface water samples will be collected during LTM to monitor plume migration, allowing continual reevaluation of this time frame.

To verify the results of the Bioscreen modeling effort, and to ensure that natural attenuation is occurring at rates sufficient to meet regulatory compliance goals, groundwater samples from two proposed wells (to replace monitoring wells TW-1105 and TW-1111 that will be destroyed during the site excavation) and four existing monitoring wells/points (TW-1110, MW-1104, ESMP-6S, and ESMP-8S) have been designated for LTM. Analytical parameters are listed in Table 7.1. In addition, five new sentry wells should be sampled annually for the parameters listed in Table 7.2. If dissolved BTEX concentrations in the sentry wells are found to exceed federal MCLs of 5 μg/L for benzene, 1,000 μg/L for toluene, 700 μg/L for ethylbenzene, or 10,000 μg/L for total xylenes, additional evaluation or corrective action may be necessary at this site. Surface water samples will be collected from three locations in the drainage canal east of the site and analyzed for BTEX (Table 7.3). Surface water sampling is intended to monitor any interception of the BTEX groundwater plume by the canal.

SECTION 9

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APPENDIX A

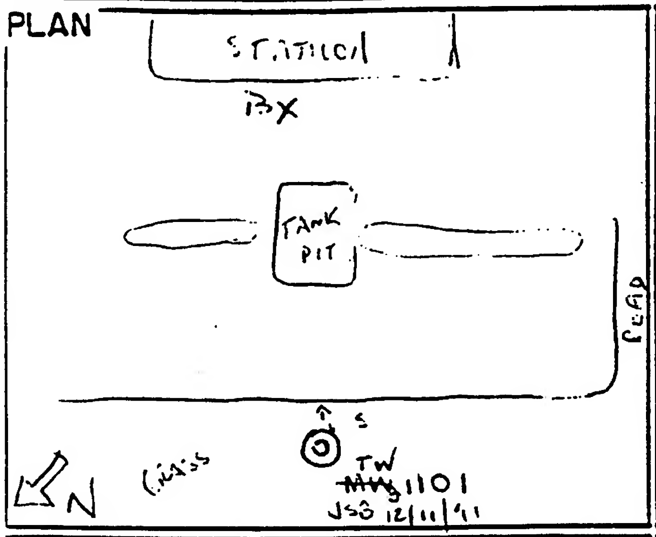
BOREHOLE LOGS, MONITORING WELL CONSTRUCTION DIAGRAMS, CPT LOGS, SLUG TEST RESULTS, AND SURVEY DATA

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER 3K98 BA	BORING NO.: TW1101
JOB NO.: 3K98	LOGGED BY: JSB
PROJ. MGR.: GVG	EDITED BY: BFN
DRILLING COMPANY: A.W POOLE	
DRILL RIG TYPE: MOBILE B-61	
DRILLING METHOD: HOLLOW STEM AUGER	
DRILLERS NAME: VINCE BARAIZA	
TOTAL DEPTH (FT.): 30'	
TIME STARTED: 0735	DATE: 12/11/91
TIME COMPLETED: 0827	DATE: 12/11/91

GROUND-WATER CONDITION AT COMPLETION OF DRILLING: GROUNDWATER AT 19' ON CORE BARREL

BACKFILLED, TIME: SEE WELL | DATE: COMPLETION FORM

WEATHER CONDITIONS: CLEAR, COOL, 40°

SURFACE ELEVATION:

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
CONT. SPLIT SPOON 0-2	2	2	VERY GOOD	1	1	0 0	CL	1 2	GRASS AT SURFACE SILTY CLAY DK BROWN, MOIST ABUNDANT ORGANICS; TR SAND 0-2'
CONT SPLIT SPOON 2-7	5	2.5	FAIR	E1101-1 (0745)	(2.5')	0 2 0	SW	3 4 5 6	SAND: MED GRAINED, WELL SORTED, BROWN - RUST COLORED, IRON-STAINING VERY EVIDENT 2-6.5 MOIST CLAY; VERY MOIST, PLASTIC, SOFT GREY - DK GREY; MINOR SILT 6.5-30.0'
CONT SPLIT SPOON 7-12'	5	5	EXCELLENT	E1101-2	JSB 12/11/91 (29') (0755)	60 90	CL	8 9 10	CLAY AS ABOVE; FUEL ODOR

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER	TW1101
JOB NO. 3K98	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	
						50		11	
CONT SPLIT SPOON	5	5	EXCELLENT	E1101-3 (14.5')	0802	4	CL/CH	12–13	CLAY AS ABOVE; MINOR SILT
						2		14–15	RUST - LT GREY; MOTTLED, TRACE MINOR ORGANICS (WOOD FRAGS) OR OXIDE NODULE
						5		16	SLIGHT FUEL ODOR
CONT SPLIT SPOON	5	5	EXCELLENT	E1101-4 (19')	0812	0	CL/CH	17–18	water on barrel @ 19'
						0		19–21	CLAY AS ABOVE;
STRAIGHT AUGER 22-30'	|	|	|	|	|	|		22–23	Driller will put on solid auger and drill to 30' to set well
								24–25	O.D. OF AUGER = 6¼"
								26–27	DRILLER REPORTS DRILLING CLAY TO 30'
								28–30	30' TD REACHED @ 0827

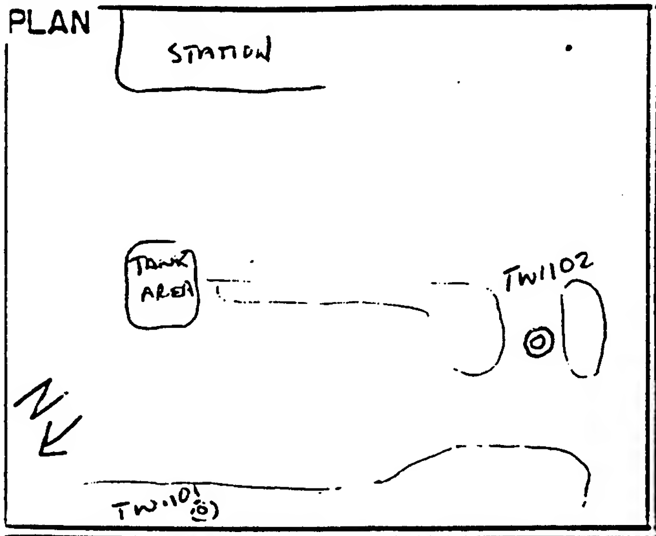
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT EAKER 3K98 BX	BORING NO. TW1102
JOB NO. 3K98	LOGGED BY: JSB
PROJ. MGR. GVG	EDITED BY: BFN
DRILLING COMPANY: AW POOL	
DRILL RIG TYPE: MOBILE B-61	
DRILLING METHOD: HOLLOW STEM Augers	
DRILLERS NAME: V. BARAZZA	
TOTAL DEPTH (FT.) 30	
TIME STARTED 0945	DATE 12/11/91
TIME COMPLETED 1738	DATE 12/11/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING Saturated zone 7.5' and 18'	
BACKFILLED, TIME —	DATE — SEE COMPLETION S
WEATHER CONDITIONS CLEAR, 50°, SL. BREEZE	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)		COMMENTS
										ASPHALT AS SURFACE
STRAIGHT AUGER 0-2	2	0	—	—	—	—		1–2	FM	Fill: clay, dark black to gray moist w/ some small gravel clusters
CONTINUOUS SPLIT SPOON 2-7	5	5	EXCELLENT	E1102-1 (3')	@1002 —	5, 6, 6	CL	3–7		Clay, brown, moist medium stiff plastic w/ some silt, trace of sand
										JSB 12/11/91 SAND STRINGER @ 7 - 7.5'; SATURATED W/ WATER
CONT SPLIT SPOON 7-12	5	5	EXCELLENT	E1102-2 (11')	@ —	7	CL/CH	8–10		CLAY; BROWN. MOIST, SOFT - MD. STIFF PLASTIC. SOME SILT. MOTTLED W/ REDDISH-GRAY MOTTLES.

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT: EAKER BX

JOB NO.: 3K98

BORING NO.: TW1102

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
						11		11	CLAY AS ABOVE
CONT SPLIT SPOON 12-17	5	5	EXCELLENT	—	—	7, 7, 7	CH	12–17	CLAY AS ABOVE; MED. STIFF - STIFF PLASTIC. DKER BROWN THAN ABOVE BARREL WET AT 18'
CONT SPLIT SPOON 17-22	5	5	EXCELLENT	E1102-3 (18')	@1026	0, 4, 5, 5	CH	17–22	CLAY AS ABOVE; SOFT - MED. STIFF - STIFF AT BOTTOM; SOME SILT; MOTTLED BROWN-GREY RED BROWN. DRILLER WILL INSERT CENTER BIT TO FINISH HOLE -
STRAIGHT AUGER 22-30	—	—	—	—	—			22–30	TD = 30

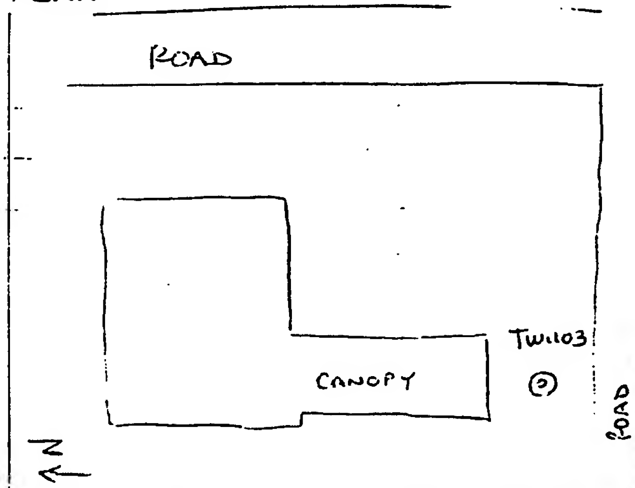
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER BX SHOPPETTE	BORING NO.: TW1103
JOB NO. 3K98	LOGGED BY: JSB
PROJ. MGR. GVG	EDITED BY: BFN
DRILLING COMPANY: AW POOL	
DRILL RIG TYPE: MOBILE B-61	
DRILLING METHOD: HOLLOW STEM AUGER	
DRILLERS NAME: V. BARRAZA	
TOTAL DEPTH (FT.) 30	
TIME STARTED 1240	DATE 12/11/91
TIME COMPLETED 1335	DATE 12/11/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING	
BACKFILLED, TIME ~1330	DATE 1/8/92
WEATHER CONDITIONS: WARM 60°, SUNNY, LT BREEZE	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
STRAIGHT AUGER	0-2	0	—	—	—	—		0–2	ASPHALT AT SURFACE
CONTINUOUS SPLIT SPOON 2-7'	5	3	GOOD	E1103-1 (3') @ 1302	E11-SU-TW1103A (3') @ 1302	250, 50, 50	CL, SW	2–7	CLAY, GREY-BROWN, SOME SILT, TR SD, MOTTLED, MOIST, STIFF; PRODUCT ODOR 0.5 - 4.5. SD (± 5') MED-FINE GRAINED, WELL-SORT W/SOME GRAVEL, GREY 4.5-7
CONT SPLIT SPOON 7-12'	5	5	GOOD	E1103-2 (10') @1300	E11-SU-TW1103B (10') @ 1300	300, 200, 200	CH	7–10	CLAY AS ABOVE, GREY-BROW W/ OXIDE NODULES, MOTTLED: STIFF, MOIST, HIGH PLASTIC, TRACE SILT

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER BX	TW1103
JOB NO. 3K98	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
						200	12/11/91 JSB ~~200~~	11–12	
CONT. SPLIT SPOON 12–17	5	5	GOOD	E1103-3 @ 1311	FROM 14'	150, 10, 6	~~150~~ CL/CH ~~10~~ ~~6ea~~	12–17	CLAY AS ABOVE; BECOMES STIFFER AND MOTTLING IS MORE APPARENT
CONTINUOUS SPLIT SPOON 17–22' JSB	5	5	EXCELLENT	E1103-4 @ 1318 (20')	—	2, 1, 1, 1	CL/CH	17–22	CLAY AS ABOVE; GREY BELOW 17' NO MOTTLING MOTTLED ZONE 19–20' CLAY IS SOFT AT BOTTOM 21–22'
CONTINUOUS SPLIT SPOON 22–27'	5	5	EXCELLENT	JSB 12/11/91 ~~E1103-~~	E11-SU-TW1103 @ 1322 (22')	0, 0, 0, 0	CL/CH	22–27	WATER ON CORE BARREL @ 22' CLAY; AS ABOVE. TR SILT BLUE-GREY W/MOTTLING; DK GREY BELOW 26'.
STRAIGHT AUGER 27–30	—	—	—	—	—	—		27–30	TD = 30'

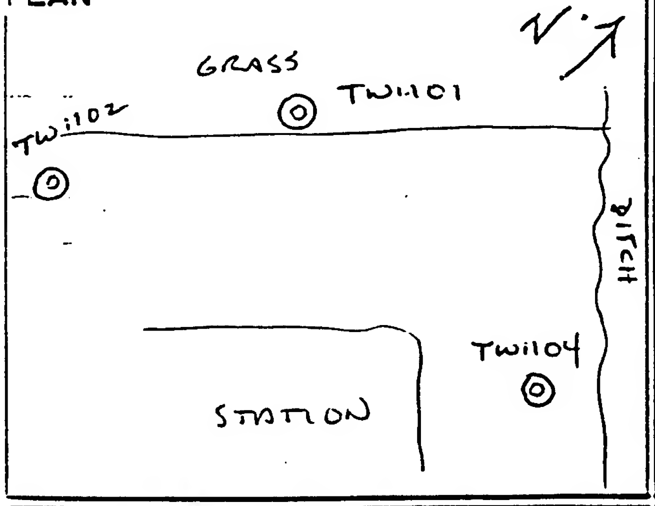
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER BX	BORING NO.: TW1104
JOB NO. 3K98	LOGGED BY: JSB
PROJ. MGR. GVG	EDITED BY: BFN
DRILLING COMPANY: AW POOL	
DRILL RIG TYPE: MOBILE B-61	
DRILLING METHOD: HOLLOW-STEM AUGER	
DRILLERS NAME: V. BARRAZA	
TOTAL DEPTH (FT.) 30	
TIME STARTED 12/11/91	[redacted] JSB 1439
TIME COMPLETED 1520	DATE 12/11/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: SATURATED ZONE ±8.5' and ± 19'	
BACKFILLED, TIME —	DATE — (SEE COMPLETION FORM)
WEATHER CONDITIONS: CLEAR, WARM 60°	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
STRAIGHT AUGER 0-2	2	1	–	–	–	–	GC	1, 2	ASPHALT AT SURFACE FILL TO 2' GRAVELLY CLAY 0-2 FILL
CONTINUOUS SPLIT SPOON 2-7'	5	5	EXCELLENT	–	–	0 5 5 5	CL/CH	3, 4, 5, 6	CLAY, DK BROWN - BROWN; VERY MOIST MED. STIFF, PLASTIC; TR SILT + SD. 2-8 CLAY
CONTINUOUS SPLIT SPOON 7-12	5	5	EXCELLENT	E1104-1(8')	@ 1455	8 6	SC/SW	7, 8, 9, 10	CLAY, BROWN, VERY MOIST; MED. STIFF PLASTIC; TR SILT + SD; MOTTLED GREENISH-GREY TO RUST COLORED; SDY ZONE 8-8.5'

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	PROJECT: EAKER BX / JOB NO. 3K98	BORING NO. TW1104
						8		11	8.5 - 12 CLAY AS ABOVE	
CONT'NUOUS SPLIT SPOON 12-17	5	5	EXCELLENT	|	|	4, 5, 6	CL / CH	12-17	CLAY AS ABOVE; SILTY CLAY ZONE 13 - 13.5'	
CONTINUOUS SPLIT SPOON 17-22	5	5	EXCELLENT	E1104-2 (20)	@1509 |	2, 3, 2	SC	17-22	CLAY AS ABOVE: LT BROWN BELOW 18'; ~~SDYX~~ JSB SANDIER ZONE 20 - 21.5' SATURATED AT ± 19'	
	NO 22	BARREL to	30'	RAN	from			22-30	TD = 30	
								31-40		

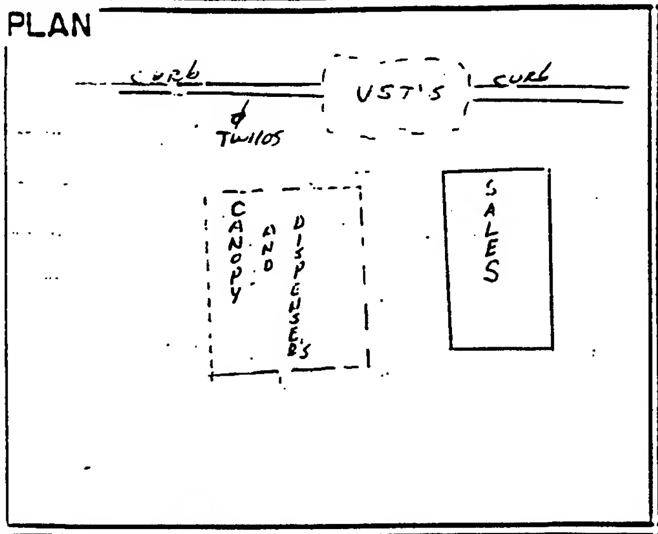
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 2 OF 2

PLAN



PROJECT	Eaker : BX Site
BORING NO.	TW1105
JOB NO.	3K98
LOGGED BY:	BFW
PROJ. MGR.	GYG
EDITED BY:	JSB
DRILLING COMPANY:	Pool
DRILL RIG TYPE:	Mobile B61
DRILLING METHOD:	Hollowstem Augers
DRILLERS NAME:	V. Barrozza
TOTAL DEPTH (FT.)	25
TIME STARTED	0725
DATE	12/13/91
TIME COMPLETED	0803
DATE	12/13/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING	Saturated at ±15 feet
BACKFILLED, TIME	—
DATE	— (SEE COMPLETION FOL
WEATHER CONDITIONS	cloudy, cool ± 48°F
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
								1
5' Split Barrel	5.0	2.7	FAIR	E11TW05-1	1	7500; 75000	SW	2–7
5' Split Barrel	5.0	5.0	Good	E11TW05-2	1	7500; 7420	SC	7–10

COMMENTS

Asphalt at surface 0.0 to 0.2'

Fill: Gravel clast mixed some fines 0.2 to 1.0'

Fill: Sand; medium to coarse grained, loose, moist non plastic. Strong Hydrocarbon odor 1.0 – 7.5

*Original soil

Sandy Clay / Clayey Sand: Grayish brown, sand is fine grained, slightly mottled, moist, medium stiff, slightly plastic. 7.5 to 13.0'

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER AFB	E11TW05
JOB NO. 3K98	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
						>5000	SC	1–2	
5' SPLIT BARREL	5.0	3.1	FAIR	1	1	>5000 >5000	SW	2–17	Saturated at ~15' ~~material from 12-17' same as above~~ JSB Sand: gray, medium grained, moist to wet, loose. 13.00 to 17.0'
NO sample barrel ran from 17 to 25'							SC	17–25	Sandy clay; brown, moist, medium stiff, to soft, moderately plastic mottled.
								25	TD=25'

Depth scale: 1, 2, 3, 4, 15, 6, 17, 8, 9, 20, 1, 2, 3, 4, 25, 6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0

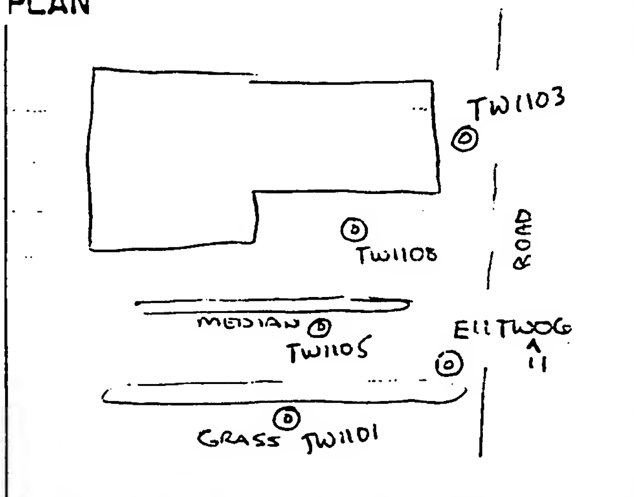
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO. E11TW1106 ~~E11TW06~~ JSG
JOB NO. 3K98	LOGGED BY: BFM
PROJ. MGR. GVG	EDITED BY:
DRILLING COMPANY: POOL	
DRILL RIG TYPE: mobile, B61	
DRILLING METHOD: Hollow stem Auger	
DRILLERS NAME: V Burrezze	
TOTAL DEPTH (FT.) 25	
TIME STARTED 0936	DATE 12/13/91
TIME COMPLETED 1020	DATE 12:13:91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated at 16.5' and at 9.0'	
BACKFILLED, TIME —	DATE SEE COMPLETION FORM
WEATHER CONDITIONS: Partly cloudy, lite breeze, cool	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
Cuttings H.L	2.0	0	|	|	|	|		0–2	Asphalt at Surface 0.0-0.3' Fill: Gravel mixed w/ fines (FM)
5' SPLIT BARREL	5.0	5.0	good	|	|	60	ML	2–3.5	Fill: Silty Clay, dark gray, moist stiff, w/some small concretions 0.3 to 3.5
						0 50	ML	3.5–7	Silty Clay, gray brown w/some sand, moist, medium stiff w/some oxide nodules, slightly mottled. 3.5 to 7.0
5' SPLIT BARREL	5.0	5.0	good	|	|	0 0	SC	7–10	Sand clay / clayey Sand, brown to gray brown, moist to wet in zones, Sand is fine grained 7.0 to 10.0

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
BAKER AFB	
JOB NO. 3K98	Ell Twe 6

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
								1
								2
5' split barrel	5.0	5.0	Good	/	/	0	CL	3
								4
						0		5
								6
						0	SW	17
5' split barrel	5.0	4.0	Good	/	/	0		8
							SW	9
						0		20
						0		21
								22
NO sample		Barrel	Ran from 18-23'				CL/CH	23
								24
								25
								6
								7
								8
								9
								0
								1
								2
								3
								4
								5
								6
								7
								9
								0

Clay; brown, w/some sand & silt
moist, medium stiff, moderate
plasticity, slightly mottled
10 - 16.5

material becomes stiffer and
more clayey from 12-16' depth

Sand seam at 16.5' to 17' depth
medium to coarse grained

Sand; gray to brownish gray
moist to wet, soft, non plastic
trace amount of clay
16.5 to 21.0

Sandy Clay / Clayey Sand Gray brown
moist, soft to medium stiff
clay content greatly increases at 22'

Transitions back into Clay w/
some sand & silt, stiff, plastic
22 to 35'

TD = 35'

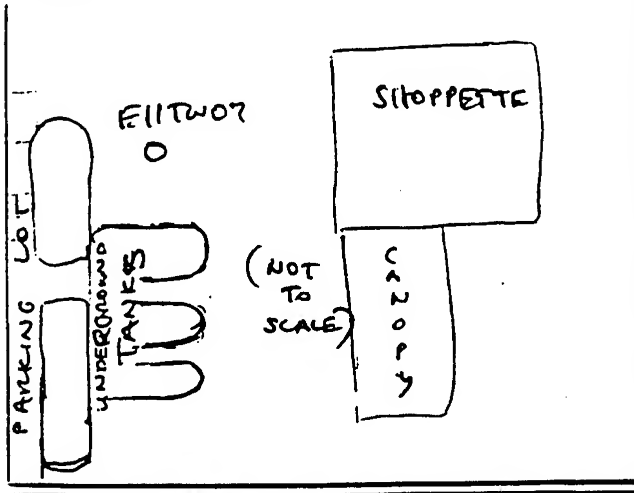
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO.: E11TW07
JOB NO. 3K98	LOGGED BY: LRE
PROJ. MGR. GVG	EDITED BY: SFN
DRILLING COMPANY: A.W. POOL	
DRILL RIG TYPE: ~~B-81~~ B-61	
DRILLING METHOD: HOLLOW-STEM AUGER	
DRILLERS NAME: VINCE BARRAZZO	
TOTAL DEPTH (FT.) 30'	
TIME STARTED 1515	DATE 12/13/91
TIME COMPLETED 1600	DATE 12/13/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: barrel saturated at ±22'	
BACKFILLED, TIME —	DATE —
WEATHER CONDITIONS: PARTLY CLOUDY, 5 MPH WIND, 55°F	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
BIT	2.0	—	—	—	—	—	FM	0–2	ASPHALT @ SURFACE. 0-3.5' Asphalt + Fill
SPLIT BARREL	5.0	3.5	EXCELLENT	E11TW07-1	—	>5000; >5000; >5000	SW/SC	2–7	3.5-6.5'; CLAYEY SAND + SANDY CLAY, ALTERNATING, SAND – MEDIUM ~~COARSE~~ GRAINED; CLAY – MODERATELY SOFT, DARK BROWN. MOIST. 6.5—10.5; CLAYEY SAND, grey, ~~sand~~ fine-grained; moist to wet.
SPLIT BARREL	5.0	5.0	EXCELLENT	—	—	>5000; >5000	SC	7–10	

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	EAKER AFB	BORING NO.	E11TW1107 ~~E11TW07~~ JRK
JOB NO.	3K98		

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
	SEE	PREV.	PAGE		—	1000	CL	11	10.5 – 21.0; BROWN-GREY CLAY, hard, plastic, mottled
						2500	CH	12–13	
SPLIT BARREL	5.0	5.0	EXCELLENT	—	—	2000 / 2500		13–17	
SPLIT BARREL	5.0	5.0	EXCELLENT	E11TW07-02	—	1500 / 2500 / 100	SC	17–22	21.0 – 22.0; SANDY CLAY, soft, brown, saturated.
BIT	5.0	|	|	|	—			22–27	BETWEEN 22 – 30 – MED. TO COARSE SAND ALTERNATING W/ MOD. HARD, DARK GREY CLAY, MOSTLY CLAY HORIZONS.
	3.0	|	|	|	—			27–30	

Depth scale: 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 0

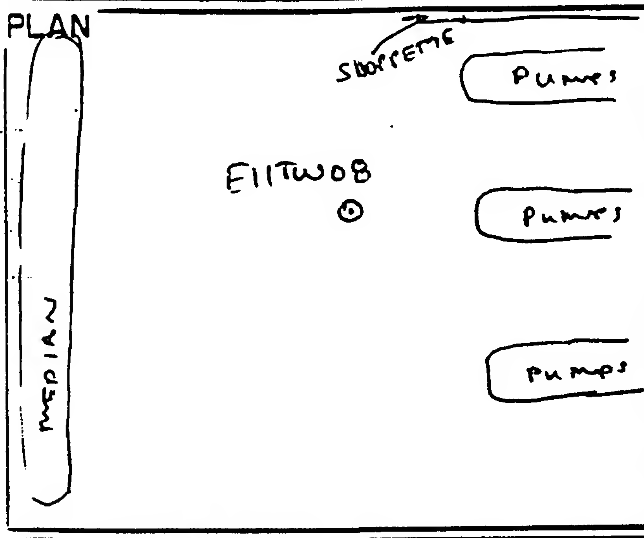
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO. E11TW1108 ~~E11TW08~~
JOB NO. 3198	LOGGED BY: LRE
PROJ. MGR. GVG	EDITED BY: BFN
DRILLING COMPANY: A.W. POOL	
DRILL RIG TYPE: B-~~81~~ 61	
DRILLING METHOD: HOLLOW STEM AUGERS	
DRILLERS NAME: VINCE BARRAZZO	
TOTAL DEPTH (FT.) 29	
TIME STARTED ~~0845~~ 0745 AM	DATE 12/14/91
TIME COMPLETED 0825	DATE 12/14/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated zones at ±10' and 21'	
BACKFILLED, TIME 2:4:00	DATE 12-18-91
WEATHER CONDITIONS: PARTLY CLOUDY, MID 40S, 10MPH WIND	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
BIT	2.0	-	-	-	-	-		0–2	ASPHALT @ SURFACE FILL, 0'-6.5', SAND, WELL SORTED, MED. TO COARSE GRAINED
SPLIT BARREL	5.0	2.5	GOOD	-	E11-SU-SB1108A	>5000 / 50	SW	2–7	6.5'-10' SANDY CLAY, BROWN W/ GREY MOTTLES, MOIST, HYDROCARBON ODOR, BECOMES SANDIER W/ DEPTH
SPLIT BARREL	5.0	5.0	EXCELLENT	-	-	>5000 / >5000	SC	7–10	

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT: FAKER
JOB NO. 3K98
BORING NO. TW ~~E11 SB08~~ E11TW

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
						150	SW	11
SPLIT BARREL	5.0	5.0	EXCELLENT	|	E11-SU-SB1108B	>5000, 150, 50	CL/CH	12–17
SPLIT BARREL	5.0	5.0	EXCELLENT	|	E11-SU-SB1108C	0, 50, 0	CL	17–22
BIT	5.0	|	|	|	|	|		22–27
BIT	2.0	|	|	|	|	|		27–29

10'-11', SAND; MEDIUM GRAINED, WET, APPEARS TO CONTAIN FREE PRODUCT

11'-21' CLAY, brown w/ grey mottles, hard, plastic

21-TD CLAY, grey, hard, moderately plastic WET @ 21.
SOME SAND ZONES PROBABLE BASED ON DRILLERS COMMENTS.

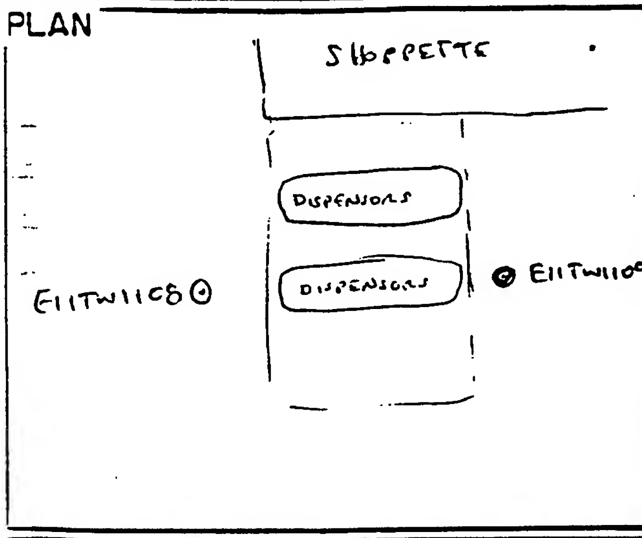
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO.: E11TW1109
JOB NO. 3K98	LOGGED BY: LRE
PROJ. MGR. GUG	EDITED BY: BFN
DRILLING COMPANY: A.W POOL	
DRILL RIG TYPE: ~~B-61~~ B61	
DRILLING METHOD: Hollow Stem Auger	
DRILLERS NAME: V. BARRAZZO.	
TOTAL DEPTH (FT.) 25	
TIME STARTED 0925	DATE 12/14/91
TIME COMPLETED 0955	DATE 12/14/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated at ± 10 and ± 21.5	
BACKFILLED, TIME —	DATE —
WEATHER CONDITIONS: CLEAR, UPPER 30s, ≈10 MPH WIND	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
BIT	2.0	—	—	—	—	—	FM	0–2
							SW	2–4.5
S.B.	5.0	3.5	GOOD	—	E11-SU-TW1109A	2000, 2500	CL/CH	2–7
S.B	5.0	4.0	GOOD	—	E11-SU-TW1109B	5000, 5000	SC, SW	7–10

COMMENTS

ASPHALT @ SURFACE

0-4.5 FILL, MOSTLY MEDIUM GRAINED SAND, WELL SORTED

4.5-6.0' CLAY, DARK BROWNISH GREY, MODERATELY SOFT, SLIGHTLY PLASTIC TRANSITION INTO LOWER BROWN CLAY

6.0-9.5' SANDY CLAY. REDDISH BROWN, GREY MOTTLES, SOME SILT.

9.5-10.5'. SAND, MED. TO FINE GRAINED, GREY; WET, FREE PRODUCT APPEARS TO BE PRESENT.

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT: EAKER
JOB NO. 3K98
BORING NO. E11TW1109

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	
						500		11	10.5–15, CLAY, MOTTLED RED + GREY, MODERATELY PLASTIC, ABUNDANT Fe_2O_3
S.B.	5.0	5.0	EXCELLENT	-	-	18	CL / CH	12–13	CONCRETIONS, MINOR SILT, MOIST. -TRANSITION INTO LOWER UNIT
						30		14–15	15–19.5 CLAY, GREY, MODERATELY
						10		16–17	PLASTIC, MINOR SILT, ~~DAMP~~ dry, SLIGHTLY MOIST
S.B	5.0	5.0	EXCELLENT	-	E11-SU-TW1109C	0		18–19	
						0		20	19.5–25.? SILTY CLAY, GREY W/SOME LT. BRN REDDISH LAMINAE, SOFT. WATER
						0		21–22	NOTED @ ~ 21.5'
BIT	-	-	-	-	-	-		23–25	TD = 25'
								6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0	

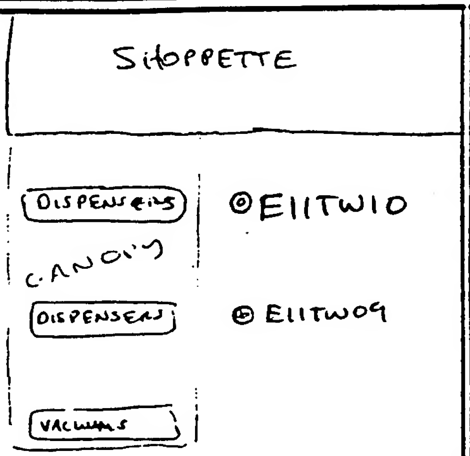
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO. E11TW1110 ~~E11TW010~~ JSS 3/31/92
JOB NO. 3K98	LOGGED BY: URE
PROJ. MGR. GUC	EDITED BY: BFN
DRILLING COMPANY: A.W POOL	
DRILL RIG TYPE: B-61	
DRILLING METHOD: HOLLOW STEM AUGER	
DRILLERS NAME: V. BARRAZZA.	
TOTAL DEPTH (FT.) 25	
TIME STARTED 1322	DATE 12/14/91
TIME COMPLETED 1355	DATE 12/14/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: SATURATED @ 8.5'	
BACKFILLED, TIME —	DATE —
WEATHER CONDITIONS: CLEAR, MID 40S, ≈10 MPH WIND	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
BIT	2.0	—	—	—	—	—	FILL	0–2	ASPHALT @ SURFACE 0-2.5' FILL (NOT RECOVERED)
S.B.	5.0	4.5	GOOD	1	E11-SU-TW1110A @7'	100 >500 >500	SC	3–7	2.5'-4.5', SANDY CLAY, DARK BROWN, ORGANIC RICH - TRANSITION W/ LOWER UNIT 4.5' - 8.5' SANDY CLAY TO CLAYEY SAND, BROWN W/ GREY MOTTLES, MOD. SOFT, DAMP.
S.B.	5.0	3.5			E11-SU-TW1110	300 20	SC	8–10	8.5-9.5 ~~8.5-9.5~~ CLAYEY SAND, BROWN W/ GREY MOTTLES, MOD. TO FINE GRAINED

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER A.F.B	E11 TW1110
JOB NO. 3K98	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
								11	8.5'-9.5' (CONTINUED) WET IN SAND ZONE.
								12	9.5'-13' CLAY, HARD, PLASTIC, BROWN
						0	CL	13	w/ GREY MOTTLES, MINOR SILT, Fe stains
							CH	14	and nodules. DAMP.
S.B	5.0	5.0	EXCELLENT	1	1	0		15	-TRANSITION ZONE w/ GREY CLAY BELOW
								16	13'-22' CLAY, GREY, HARD PLASTIC,
						0		17	SOME RED STAINS, MINOR SILT
						0		18	
								19	22-25' BIT (NO RECOVERY)
S.B	5.0	5.0	EXCELLENT	1	1	0		20	
						0		21 ▽	
								22	
								23	
BIT	–	–	–	–	–	–		24	
								25	
								6	TD = ~~22~~ 25'
								7	
								8	
								9	
								0	
								1	
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								0	

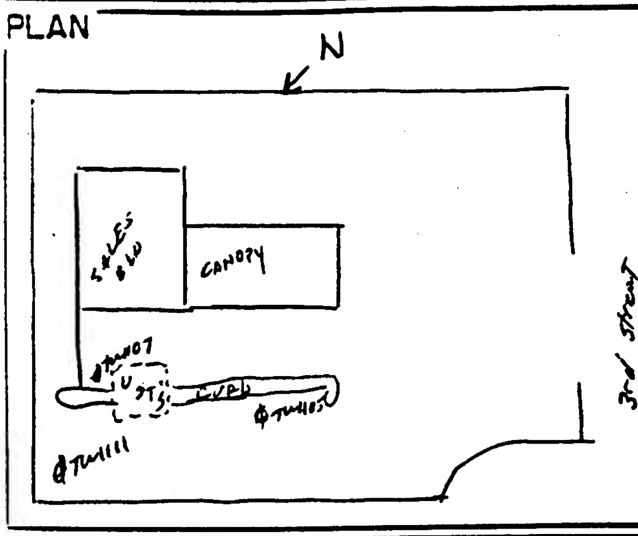
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO.: E11TW111
JOB NO.: 3K98	LOGGED BY: BFN
PROJ. MGR.: GVG	EDITED BY: ~~BFN~~ BEN
DRILLING COMPANY: Pool	
DRILL RIG TYPE: Mobile, B61	
DRILLING METHOD: 6¼" Hollow stem Augers	
DRILLERS NAME: V. Barrazza	
TOTAL DEPTH (FT.): 22'	
TIME STARTED: 0753	DATE: 12-15-91
TIME COMPLETED: 0818	DATE: 12-15-91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated at ≈ ±10 and at ±21'	
BACKFILLED, TIME	DATE
WEATHER CONDITIONS: clear, cold, light breeze ≈ 30°F	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
Split SPT	2	0	—	—	—	—		0–2	Asphalt at surface 0.0–0.3. Fill; gravel mixed w/ fines 0.3–1.0'
5' split barrel	5'	2'	Poor	E11TW111-1	1	>500; >500; >500; >500	SW	2–7	Fill: Sand, brown to gray brown, medium to coarse grained, loose 1.0 to 7.0. Clay, brown, with silt and trace of sand, moist, soft to medium stiff,
5' split barrel	5'	5'	[illegible]	E11TW111-2		>500; >500; 600	CL / SC	7–10	Saturated zone ≈10'. Sandy zone w/ clay very moist to wet, soft 10 to 11.0'

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER AFB	
JOB NO. 3K58	E11TW111

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	
								1	
								2	Silty clay, brown, w/ some sand
						600	CL	3	mottled zones, very moist, medium
						600		4	stiff 11.0 - 16
5' split barrel	5'	5	Good	1	1			5	
						600		6	
								7	Clay, blue gray, moist, very stiff
							CL/CH	8	plastic, some silt present, mottled
						600		9	16-22'
5' split barrel	5'	5'	Good	1	1	0		20	
								1	Saturated zone at ≈ 21'
						0		2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								0	

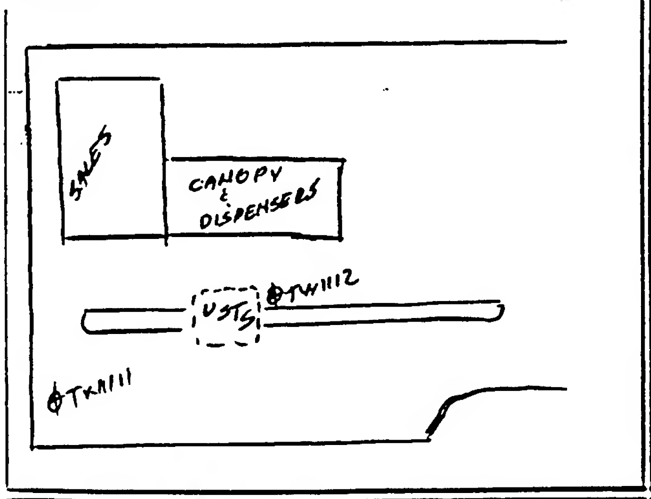
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO.: E11TW1112
JOB NO. 3K98	LOGGED BY: BFN
PROJ. MGR. GVG	EDITED BY: VSB
DRILLING COMPANY: Pool	
DRILL RIG TYPE: Mobile B61	
DRILLING METHOD: 6 1/4 Hollow stem Auger	
DRILLERS NAME: V. Barrazza	
TOTAL DEPTH (FT.) 25	
TIME STARTED 0915	DATE 12-15-91
TIME COMPLETED 1030	DATE 12-15-91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: Saturated zones ±8.5', ±10.5' and ±21'	
BACKFILLED, TIME 13:40	DATE 12-16-91
WEATHER CONDITIONS: clear, cold, light breeze ≈30°F	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
Solid Bit	2	0	—	—	—	—	FM	0–2
5' Split Barrel	5'	4'	Good	—	—	75000; 75000; 75000	CL/SC	2–7
5' Split Barrel	5'	5'	Good	—	—	35000; 75000	SW; SG/CL	7–10

COMMENTS

Asphalt at surface 0.0–0.3

Fill: Gravel clast mixed w/ fines 0.3–1.0

Sandy clay, grey w/ some silt moist, soft, trace organics (root hairs) possible fill strong hydrocarbon odor.

Sand seam ≈ 8' to 8.5', saturated

Sand seam ≈ 10 to 10.5' saturated

Clay content begin to increase below 10.5'

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER AFB	
JOB NO. 3K98	E11TW1112

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
						2500		11	
5' SPLIT BARREL	5	5	good	1	1	2000 / 10 / 0	CL/CH	12–16	Clay, brownish gray, slightly mottled, moist medium stiff some silt, trace of sand, plastic 10.5 – 15.0
5' SPLIT BARREL	5	5	good	1	1	0 / 0 / 0	CL/CH	17–21	stiffness increases with depth Clay, blue gray, moist, stiff plastic
solid bit	no sample barrel ran from 22-25'							22–25	saturated zone at ±21' 15 – 25'
								26	TD=25'

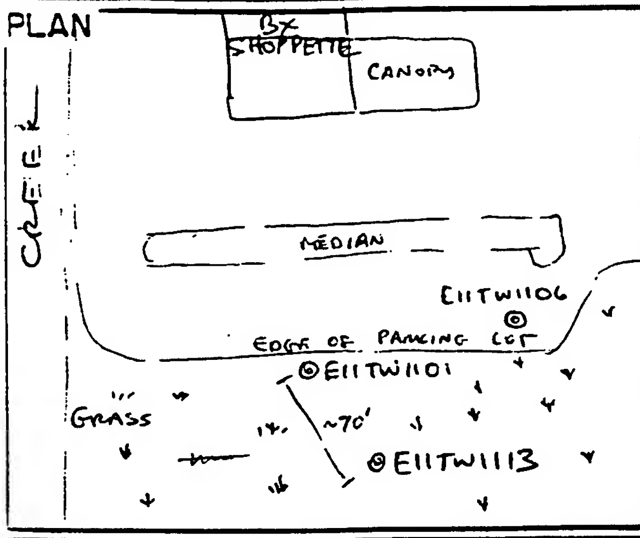
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO. E11TW1113
JOB NO. 3K98	LOGGED BY: LRE
PROJ. MGR. GVG	EDITED BY: BFN
DRILLING COMPANY: AW POOL	
DRILL RIG TYPE: B-61	
DRILLING METHOD: HOLLOW STEM AUGER	
DRILLERS NAME: V. BARRAZZA	
TOTAL DEPTH (FT.) 27	
TIME STARTED 1350	DATE 12/15/91
TIME COMPLETED 1445	DATE 12/15/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated zones at 5-10' and 22'	
BACKFILLED, TIME 0739	DATE ~~12~~-18-91
WEATHER CONDITIONS: CLEAR, SMALL WIND, MID 40s	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	
BIT	2.0	-	-	-	-	-	ML	0–2	NR
SPLIT BARREL	5.0	5.0	GOOD	-	-	0, 0, 0	SW, CL	2–7	
SPLIT BARREL	5.0	5.0	GOOD	-	-	0, 0	CL / ML	7–10	

COMMENTS

GRASS @ SURFACE

0'-3' PLOW ZONE & POSSIBLY FILL.
2'-3' MED. TO COARSE GRAINED SAND, DAMP, SOME BLACK ORGANICS AND RED IRON CONCRETIONS
3'-4.5' SILTY CLAY, DARK BROWN, VERY MOIST, SOFT, MOD. PLASTIC
4.5-10'. SILTY SANDY CLAY, LT BROWN W/ RED & GREY MOTTLES, BECOMES LIGHTER IN COLOR W/ DEPTH, MORE GREY W/ DEPTH. ZONES HAVE WATER IN 8'-10' ~~INTERVAL~~. SANDY INTERVALS ARE 1'-6' ~~THICK~~.

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER AFB	E11TW113
JOB NO. 3K98	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
	PREVIOUS			PAGE		0		11–12
S.B.	5.0	5.0	EXCELLENT	:	1	2 0 0	CL/CH	12–17
S.B	5.0	5.0	EXCELLENT	E1113-01 @22'	1	0 2 7	SW	17–22

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0

10'-21' CLAY, LT BROWN TO GREY, SILTY; RED IRON STAINS 12'-21'.
- BECOMES GREYER & LESS SILTY IN 12'-19.5' INTERVAL, PLASTIC, HARD

- 19.5-21', BECOMES LT BROWNISH RED, LESS PLASTIC, MORE SILTY THAN ABOVE

21'-27' SAND, COARSE GRAINED, MOD. WELL SORTED, WET.

22'-27' IS SAND (as per drillers comm...

TD = 27'

NOTES:

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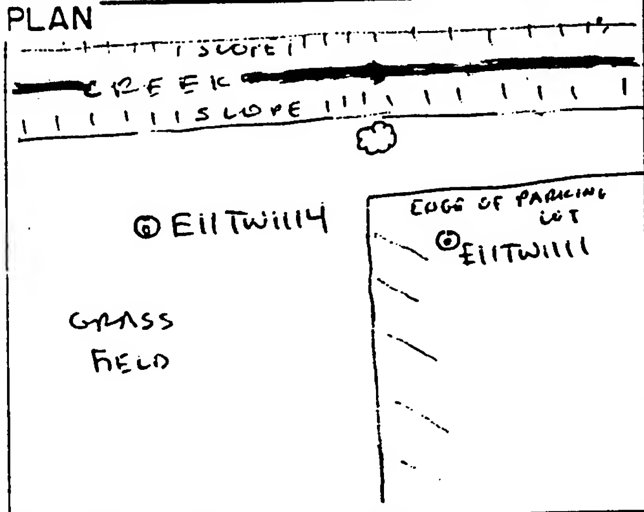
FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO.: E11 TW1114
JOB NO. 3K98	LOGGED BY: LRE
PROJ. MGR. GVG	EDITED BY: BFN
DRILLING COMPANY: A.W POOL	
DRILL RIG TYPE: B-61	
DRILLING METHOD: HOLLOW STEM AUGER	
DRILLERS NAME: V. BARRAZA	
TOTAL DEPTH (FT.) 24'	
TIME STARTED 0955	DATE 12/16/91
TIME COMPLETED 1105	DATE 12/16/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated zone at ±8 and ±21'	
BACKFILLED, TIME —	DATE —
WEATHER CONDITIONS: CLEAR, MID 30s, 5 MPH WIND	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
BIT	2.0	—	—	-	—	—		1, 2
S.B.	5.0	3.0	GOOD	1	1	0, 0, 0	SW, CL/CH	3, 4, 5, 6, 7
S.S	5.0	4.5	EXCELLENT	1	1	0, 0	CL/CH	8, 9, 10

COMMENTS

GRASS @ SURFACE

0-4' NO RECOVERY

4.0-5.0 SAND, MED GRAINED, MOIST.

5'-6' SILTY CLAY, DARK BROWN, MOD. SOFT, SLIGHTLY PLASTIC, MOIST. MINOR SAND

6'-13' SANDY, SILTY CLAY, ~~BROWN~~ w/ GREY MOTTLES. MORE CLAYEY ZONES SLIGHTLY PLASTIC, ~~MINOR~~ IRON STAINS 12'-13'.

WET ZONE 8'-10' IN MORE SANDY ~~ZONES~~ INTERVALS

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT: EAKER AFB
JOB NO. 3K98
BORING NO. E11 TW1114

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
S.B	SEE PREV PAGE					0		11–12	-TRANSITION W/ LOWER GREY UNIT @ 13'
S.B	5.0	5.0	EXCELLENT	-	-	0, 0, 0	CL/CH	13–17	13'–21' CLAY, GREY, HARD, PLASTIC, RED IRON STAINS 13'–16'. -BECOMES HARDER + MORE PLASTIC W/ DEPTH.
S.B.	5.0		EXCELLENT	E1114-1	-	0, 0, 0	SW	18–22	21'–24'* SAND, COARSE GRAINED; WET; MOD. WELL SORTED. WET @ ~21'
BIT	2.0	-	-	-	-	-		23–24	TD=24

NOTES: * As per drillers comments

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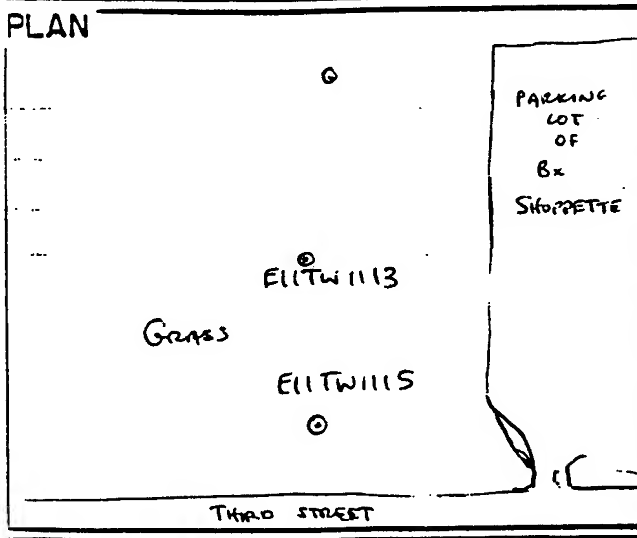
FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO.: E11TW1115
JOB NO. 3K98	LOGGED BY: LRK
PROJ. MGR. GVG	EDITED BY: BFN
DRILLING COMPANY: A.W. POOL	
DRILL RIG TYPE: B-61	
DRILLING METHOD: HOLLOW STEM AUGER	
DRILLERS NAME: V. BARRAZA	
TOTAL DEPTH (FT.) 22'	
TIME STARTED 1320	DATE 12/16/91
TIME COMPLETED 1420	DATE 12/16/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated zones at ± 7' and 17'	
BACKFILLED, TIME	DATE
WEATHER CONDITIONS: CLEAR, MID TO UPPER 40s, LIGHT WIND	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
									GRASS @ SURFACE
BIT	2.0	-	-	-	-	-		1	0-2 NO RECOVERY
SB	5.0	5.0	EXCELLENT	-	-	0, 0, 0	CL, ML/CL	2–7	2'-3' CLAY, DARK BROWN, ORGANIC RICH, ABUNDANT ROOT HAIRS. MOIST 3'-9' CLAYEY SANDY SILT/SILTY SANDY CLAY; BROWN. SILTY ZONES ~~[illegible]~~ ARE MORE FRIABLE THAN CLAYEY ZONES. ROOT HAIRS + ORGANICS @ TOP. MOIST
SB	5.0	5.0	EXCELLENT	E115-1 @ 8'		0, 0	CL/CH	7–10	- WET ZONE ~7' WHERE MORE SAND IS PRESENT 9'-19' CLAY, BROWNISH GREY w/ RED MOTTLES, HARD, PLASTIC. MINOR SD + SILT

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	Eaker AFB	BORING NO.	E11TW1115
JOB NO.	3K98		

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
	SEE PREV. PAGE							11	MOIST 9-
								12	- IRON STAINS 11'-12'
						0		13	
S.B.	5.0	5.0	Excellent			0		14–15	
						0		16–17	
				19'-20'		0		18	
S.B.	5.0	5.0	Excellent	E1115-2		0	SC	19–20	19-22 CLAYEY SAND, LAMINATED. SAND FINE GRAINED - SAMPLE SATURATED @ 19.5'. VERY MOIST TO WET UP TO 17'. GREYISH BROWN W/REDDISH ~~LAMINAE~~ TAN LAMINAE
						2		21–22	
								23	
									TD = 22'

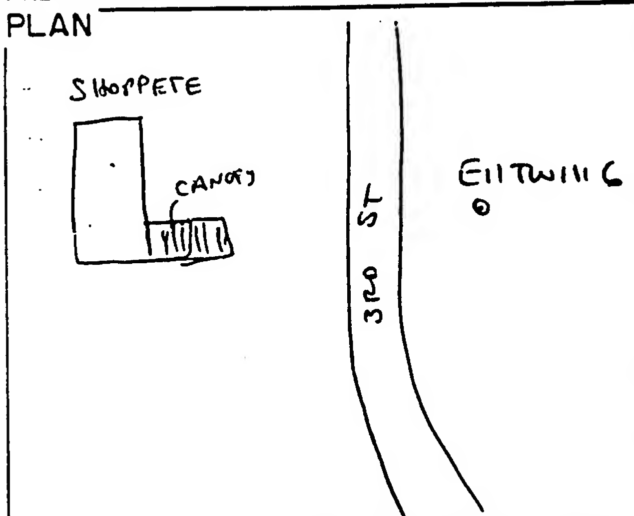
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB	BORING NO.: E11TW1116
JOB NO. 3K98	LOGGED BY: JRG
PROJ. MGR. GJG	EDITED BY: BFN
DRILLING COMPANY: A.W. POOL	
DRILL RIG TYPE: B-61	
DRILLING METHOD: HOLLOW STEM AUGER	
DRILLERS NAME: V. BARRAZA	
TOTAL DEPTH (FT.) 22'	
TIME STARTED 1530	DATE 12/16/91
TIME COMPLETED ~~1425~~ 1600 BFN	DATE 12/16/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: SATURATED ZONE ± 10 and ±7, ±15'	
BACKFILLED, TIME —	DATE —
WEATHER CONDITIONS: CLEAR, MID 50s, LIGHT WIND	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	COMMENTS
BIT	2.0	—	—	—	—	—		1, 2	Grass @ Surface 0-2.5' No recovery
S.B.	5.0	4.5	Good	|	|	0, 0, 0	CL, ML	3, 4, 5, 6, 7	2.5-6 Silty Clay, Dark Brown w/ Red Mottles - Moist ~~Hard~~ 6-10.5' Clayey Sandy Silt, Brown w/ Reddish Mottles, Very Moist. - Wet in zones w/ less ~~clay~~ Reddish Laminae.
S.B	5.0	4.0	Good	E1116-1 10'-12'	|	0, 0		8, 9, 10	Saturated in core barrel @ ~8' in 6" zone that less clayey.

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER AFB	E11TW1116
JOB NO. 3K98	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
							CL	11–12	10.5–12.5, SILTY CLAY, BROWNISH GREY W/ REDDISH MOTTLES, MODERATELY HARD, PLASTIC, VERY MOIST.
S.B.	5.0	5.0	Good	1	1	0 0 0	CL/CH	12–17	12.5–22, CLAY, BLUE GREY, MOD. SOFT, MOIST, PLASTIC. SOME SILTY ZONES. - REDDISH HEMATITE/LIMONITE @ 14'-16'
S.B	5.0	5.0	Good	E1116-02 @18'	1	0 0 0		17–22	- 17-19' WET, MORE SILTY THAN DRIER ZONES ABOVE + BELOW. ~~NON PLASTIC~~ Lo - SMALL HEMATITE STAINS 18.5'-20'.
								23–30	TD = 22'

NOTES:

* WATER ON CORE BARREL @ 21'

NUS

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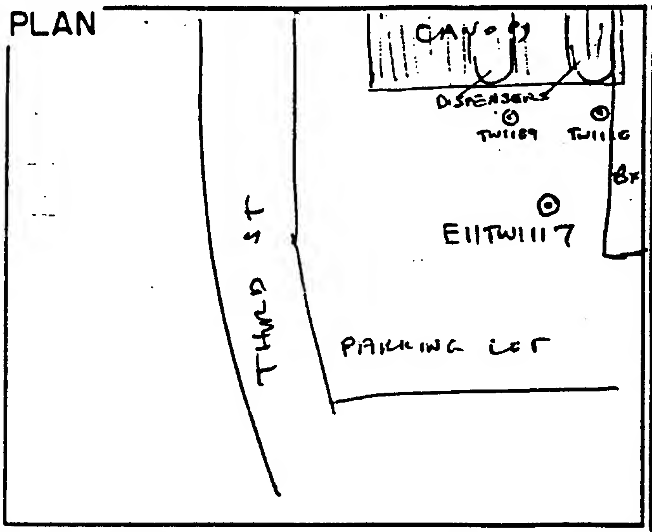
FIELD LOG OF BORING

SHEET 1 OF 1 ~~2~~

PLAN



PROJECT: EAKER AFB	BORING NO.: E11TW1117
JOB NO. 3198	LOGGED BY: LRE
PROJ. MGR. GVG	EDITED BY: BFN
DRILLING COMPANY: AW POOL	
DRILL RIG TYPE: ~~HOLLOW STEM AUGER~~ MOBILE B61 BFN	
DRILLING METHOD: HOLLOW STEM AUGER	
DRILLERS NAME: V. BARRAZA	
TOTAL DEPTH (FT.) 12	
TIME STARTED 0815	DATE 12/17/91
TIME COMPLETED 0826	DATE 12/17/91
GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated zone at ±8.5'	
BACKFILLED, TIME 1622	DATE 12-17-91
WEATHER CONDITIONS: CLEAR, MID 30s, 5 MPH WIND	
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
BIT	2.0							0–2
SPLIT BARREL	5.0	3.5	GOOD	E1117-1	E11-SU-TW1117A @7'	0 / 2 / 400	ML	2–7
SPLIT BARREL	5.0	5.0	EXCELLENT	/	/	30 / 170	CL	7–12

COMMENTS

ASPHALT @ SURFACE

0-3.5' NO RECOVERY

3.5-5.0' CLAYEY SILT, DARK BROWN, ORGANIC HORIZON, DRY.

5.0'-9.5' SILTY CLAY, REDDISH BROWN W/ GREY MOTTLES BECOMES GREYER W/ DEPTH. MOIST TO WET.
- WET IN MORE SILTY HORIZONS (SEE BELOW)
- STRONG ~~[illegible]~~ ODOR

- 8.5 to 9.5 WET, FREE WATER VISIBLE IN TWO 4" ZONES

9.5'-12' CLAY, GREY W/ LT BRN MOTTLES, SILTY; SOME REDDISH-BLACK STAINS (Fe?) PLASTIC, MOD. HARD. MOIST

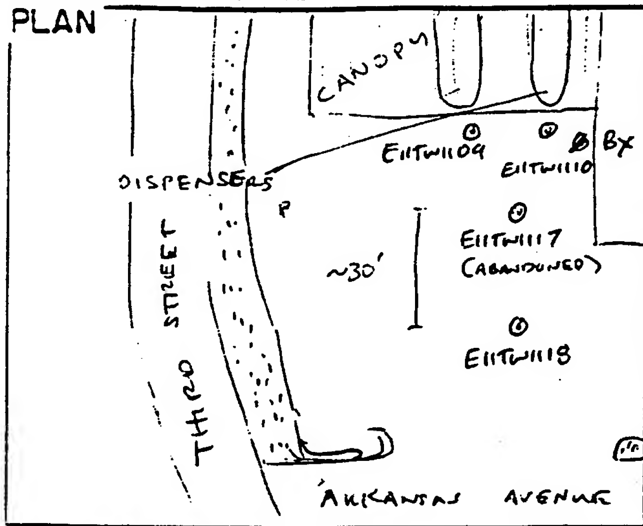
CL

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 1

PLAN



PROJECT: EAKER AFB

BORING NO.: E11TW1118 (ABANDONED BEFORE CASING PLACED IN WELL)

JOB NO. 3K98

LOGGED BY: URE

PROJ. MGR. GVG

EDITED BY: GFN

DRILLING COMPANY: A.W. POOL

DRILL RIG TYPE: ~~Hollow Stem Auger~~ MOBILE B61 ~~8-6~~ GFN

DRILLING METHOD: Hollowstem Augers

DRILLERS NAME: V. BARRAZA

TOTAL DEPTH (FT.) 12

TIME STARTED 0855 DATE 12/17/91

TIME COMPLETED 0920 DATE 12/17/91

GROUND-WATER CONDITION AT COMPLETION OF DRILLING: Saturated zone at ± 8.5'

BACKFILLED, TIME 16:35 DATE 12-17-91

WEATHER CONDITIONS: CLEAR, MID 40S, LIGHT WIND

SURFACE ELEVATION

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
BIT	2.0	0	-	-	-	-	-	0–2
S.B.	5.0	5.0				0 / 3 / 2	CL / CL-CH	2–7
SB	5.0	5.0		E1118-1 @8'; E1118-2 @12'		30 / 90		7–10

COMMENTS

ASPHALT @ SURFACE

2'-5' SILTY CLAY, DARK BROWN TO GREYISH BROWN; SLIGHTLY PLASTIC, MODERATELY HARD,
- HYDROCARBON ODOR
-

5'-9.5' SILTY CLAY, GREYISH BROWN W/ RED MOTTLES, SLIGHTLY MOIST TO WET.
- 8.5'~~-9.5'~~ WET IN ~~MORE~~ SILTY ZONES
TWO 3"-4" ZONES HERE W/ FREE WATER

9.5'-12' CLAY, GREY W/ LT REDDISH BRN MOTTLES, PLASTIC, MOD. HARD, MOIST

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
SEE	PREV.			PAGE		0		11
								12
						0	CL/CH	13
S.B	5.0	5.0	EXCELLENT	1	1	0		14
								15
						0		16
								17
						0		18
S.B.	5.0	4.0	EXCELLENT	E1119-02	1		CL	19
						0		20
						0		21
								22

PROJECT: EAKER AFB

JOB NO. 3K98

BORING NO. TW1119

17'
12 - ~~20~~ CLAY, GREY; HARD, PLASTIC, ABUNDANT Fe STAINS AND "NODULES" FOLLOWING OLD ROOT HOLES; MINOR SILT; DAMP

20' SILTY
17' - ~~20.5~~ CLAY, BROWNISH GREY W/ ABUNDANT RED Fe STAINS + "NODULES" ~~SILTY~~ - WET @ 18'

20' - 21'
~~20.5~~ - ~~21~~ CLAY, GREY, HARD, PLASTIC, ABUNDANT Fe STAINS AND "NODULES" (SAME AS 12'-17' INTERVAL)

TD = 22

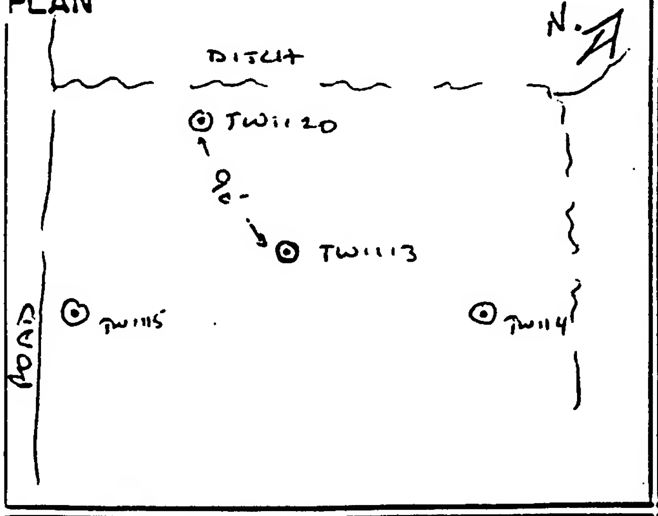
NOTES:

NUS CORPORATION

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT: EAKER AFB BX Shoppette

BORING NO.: TW1120

JOB NO. 3K98

LOGGED BY: JSB

PROJ. MGR. GVG

EDITED BY: BFN

DRILLING COMPANY: A.W. Pool

DRILL RIG TYPE: Mobile B-61

DRILLING METHOD: Hollow stem auger

DRILLERS NAME: V. Barazza

TOTAL DEPTH (FT.) 30

TIME STARTED 1019 DATE 1-7-92

TIME COMPLETED 1112 DATE 1-7-92

GROUND-WATER CONDITION AT COMPLETION OF DRILLING: saturated zone at ≈9' and 11' and 21'

BACKFILLED, TIME / DATE: 1/9/92 SEE WELL COMPLET. FORM

WEATHER CONDITIONS: cool, 45°, ptly cloudy, light breeze

SURFACE ELEVATION

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
STRAIGHT AUGER 0-2	2	1	1	1	1	1		0-2
CONTINUOUS SPLIT SPOON 2-7	5	3.5'	GOOD	1	1	0, 0, 0, 0	SM, SS	2-7
CONTINUOUS SPLIT SPOON 7-12	5	5	EXCELLENT	1	1	2, 4	CL	7-10

COMMENTS

GRASS AT SURFACE

DK BROWN - BROWN SILTY SAND w/ SOME CLAY, ORGANICS ABUNDANT SAND IS MED - COARSE GRAINED WELL SORTED QTZ + ROCK FRAGS. FRIABLE, MOIST 0 - 6'

DK BROWN - BROWN SILTY CLAY MOIST, MOTTLED, PLASTIC TR SAND ~~6 - 9~~ 6 - 12'

SILTY CLAY ~~[illegible]~~ ous TO 9' (LT BROWN TO BROWN)

SATURATED ZONE AT 9'; (9-9.5

SDY CLAY AS ABOVE, SATURATED

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT	BORING NO.
EAKER AFB	TW1120
JOB NO. 3K98	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
						4	▽	11–12
CONT SPLIT SPOON 12-17	5	5	EXCELLENT	|	|	0, 3, 0, 0	SC	12–17
CONT SPLIT SPOON 17-22	5	5	EXCELLENT	|	|	0, 1, 1, 1	CL ▼	17–22
CONT SPLIT SPOON 22-27	5	5	EXCELLENT	|	|	0, 0, 0, 0	ML	22–27
AUGER TO 30' 27-30	3	|	|	|	|	|		27–30

LITHOLOGY FROM 6 - 12.5 IS PREDOMINANTLY A SANDY CLAY/CLAYEY SD SATURATED ZONES HAVE CONSIDERABLE MORE SAND IN THEM (CLAYEY SAND).

GREY-BROWN MOTTLED CLAY W/TR SILT, SD STIFF, PLASTIC - MED. PLASTIC 12.5 - 27 (SD STRINGER AT 13

CLAY AS ABOVE - MOTTLING DECREASES BELOW 18.5' CLAY BECOM MUCH GRAYER IN COLOR

BARREL WET AT ~~22~~ 21

CLAY AS ABOVE SOFT, (SATURATED) PLASTIC, TRACE OXIDE NODULES, AND COARSE GRAINED SAND.

TD = 30' Driller reports clay to TD

NOTES:

SENT BY:BROWN AND ROOT,ENV ;12-21-95 ; 4:21PM ; → 13038318208;# 2/21

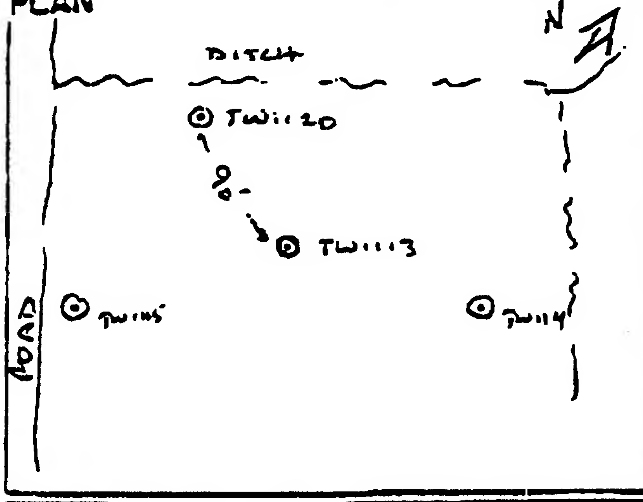
NUS CORPORATION

MW1120

FIELD LOG OF BORING

SHEET 1 OF 2

PLAN



PROJECT	EAKER AFB BX Shoppette
BORING NO.	TW1120
JOB NO.	3K98
LOGGED BY:	JSB
PROJ. MGR.	GVG
EDITED BY:	BFN
DRILLING COMPANY:	A.W. Pool
DRILL RIG TYPE:	Mobile B-61
DRILLING METHOD:	Hollow stem auger
DRILLERS NAME:	V. Barragan
TOTAL DEPTH (FT.)	30
TIME STARTED	1019
DATE	1-7-92
TIME COMPLETED	1112
DATE	1-7-92
GROUND-WATER CONDITION AT COMPLETION OF DRILLING	Saturated zone at 29' and 11' and 21'
BACKFILLED, TIME	
DATE	1/9/92 SEE WELL COMPLETION FORM
WEATHER CONDITIONS	cool, 45°, ptly cloudy, light breeze
SURFACE ELEVATION	

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)
Straight auger 0-2	2	-	-	-	-	-		1, 2
Continuous split spoon 2-7	5	3.5'	GOOD	-	-	0, 0, 0, 0	SM, 3S5	3, 4, 5, 6, 7
Continuous split spoon 7-12	5	5	EXCELLENT	-	-	2, 4	CL	8, 9, 10

COMMENTS

GRASS AT SURFACE

DK BROWN - BROWN SILTY SAND w/ SOME CLAY, ORGANICS ABUNDANT SAND IS MED - COARSE GRAINED WELL SORTED QTZ + ROCK FRAGS. FRIABLE, MOIST 0 – 6'

DK BROWN - BROWN SILTY CLAY MOIST, MOTTLED, PLASTIC TR SAND ~~6 - 9~~ 6 - 12'

SANDY SILTY CLAY AS ABOVE TO 9' (LT BROWN TO BROWN)

SATURATED ZONE AT 9'. (9 - 9.5'

SDY CLAY AS ABOVE; SATURATED ZONE 11 - 11.5'

MW1120

FIELD LOG OF BORING (CONT'D.)

SHEET 2 OF 2

PROJECT EAKER AFB

JOB NO. 3K98

BORING NO. TW1120

SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNU/SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)	DESCRIPTION
						4		11	LITHOLOGY FROM 6-12.5 IS PREDOMINANTLY A SANDY CLAY / CLAYEY SD SATURATED ZONES HAVE CONSIDERABLE MORE SAND IN THEM (CLAYEY SAND).
CONT SPLIT SPOON 12-17	5	5	EXCELLENT	|	|	0, 3, 0, 0	SC	12–17	GREY-BROWN MOTTLED CLAY W/ TR SILT, SD STIFF, PLASTIC - MED. PLASTIC 12.5-27 (SD STRINGER AT 13')
CONT SPLIT SPOON 17-22	5	5	EXCELLENT	|	|	0, 1, 1, 1	CL	17–22	CLAY AS ABOVE - MOTTLING DECREASES BELOW 18.5' CLAY BECOME MUCH GRAYER IN COLOR. BARREL WET AT ~~22'~~ 21.5
CONT SPLIT SPOON 22-27	5	5	EXCELLENT	|	|	0, 0, 0, 0	ML	22–27	CLAY AS ABOVE, SOFT, (SATURATED) PLASTIC, TRACE OXIDE NODULES AND MED COARSE GRAINED SAND.
AUGER TO 30' 27-30	3	|	|	|	|	|		27–30	TD = 30' Driller reports clay to TD

NOTES:

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1121
SHEET 1 OF 2

PROJECT: EAKER AFB RFI	JOB NO.: 0114	BORING/WELL NO.: MW1121	
	LOGGED BY: BDH	TOTAL DEPTH OF BOREHOLE: 16.7'	
DRILLING CONTRACTOR: Tri-State Testing		SURFACE ELEV.:	DATUM:
DRILLER'S NAME: Joe Flegger		START TIME: 0818	DATE: 4/8/95
DRILL RIG TYPE: CME-55		FINISH TIME: 0920	DATE: 4/8/95
BORING METHOD: HSA		WATER DEPTH:	
HOLE DIAMETER: 7¼", 10¼"		DATE:	
SAMPLING METHOD: Continuous		TIME:	
HAMMER WGT.: NA	DROP HGT: NA	BACKFILLED, TIME:	DATE:
SURFACE CONDITIONS: Grass		WEATHER: Fair, lo 60°F, very strong wind, gusty	

SKETCH OF BORING LOCATION

SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY
					0	sl. moist	soft	10YR 4/3		1.	1.1'
					0		soft	10YR 6/3		2	
2.7'			2.7'	2.7'		moist		10YR 5/3	2.7 – 3.2	3	2.9'
↑			5'		0	wet		10YR 3/2		4	4.0'
				3'				10YR 4/3		5	
					0	wet	soft			6	
					0					7	
↓ 7.7'					0	moist	firm			8	
7.7'			5'	2.8						9	
↓											

MATERIAL DESCRIPTION

0.5' – 1.1' Silt, clayey, sdy, rootlets, sl. moist, brown

1.1 – 2.9 Sand, well sorted, fine grnd, moist, pale brown

2.7'–3.2' E11-SU-MW1121A @ 0832

2.9' – 4.0' Clay, silty, minor sd., very moist to wet at [illegible], wet @ 3.4', very dark grayish brn, mottled [illegible] / orange brn.

4.0' – 13.8' Clay, silty, brn, mottled, orange brn, olive gray

NOTES: ______________________ EDITED BY/DATE: ______________

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW121

SHEET 2 OF 2

PROJECT: EAKER AFB RFI | JOB NO.: 0114 | BORING NO.: MW112'

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.	
↓										11		11.7' Clay, less silt content, is firm
						moist		10YR 4/3		12		
12.7					0		firm			13		
↑										14	13.8'	13.8' - 16.3' Clay, sl silty, firm, moist, dk gray, mottled orange brn, reddish brn along old fractures.
↓			2.6'	2.6'	0	moist	firm	10YR 4/1		15		
↓										16		
16.3										17		

NOTES:

EDITED BY/DATE:

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1122
SHEET 1 OF 2

PROJECT: EAKER AFB RFI	JOB NO.: 0114		BORING/WELL NO.: MW1122
	LOGGED BY: BDH		TOTAL DEPTH OF BOREHOLE: 17.9
DRILLING CONTRACTOR: Tri-State Testing		SURFACE ELEV.:	DATUM:
DRILLER'S NAME: Joe Flagger		START TIME: 1236	DATE: 4/7/95
DRILL RIG TYPE: CME-55		FINISH TIME: 1430	DATE: 4/7/95
BORING METHOD: HSA		WATER DEPTH:	
HOLE DIAMETER: $7\frac{1}{4}$"		DATE:	
SAMPLING METHOD: Continuous		TIME:	
HAMMER WGT.: NA	DROP HGT: NA	BACKFILLED, TIME:	DATE:
SURFACE CONDITIONS: Grass		WEATHER: Fair, upper 70's F, easterly wind	

SKETCH OF BORING LOCATION

SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY	MATERIAL DESCRIPTION
0.5					0	dry	soft	2.5Y 4/4		1	1.1	0.5'–1.1' Sand, fine grained, silty, sl. clayey, w/mottles, olive brn.
					0	sl. moist	soft	2.5Y 6/4		2	1.8	1.1'–1.8' Sand, fine grained, silty, sl. moist, light yellowish brown
↓ 2.8			2.3'	2.3'	0	moist		2.5Y 4/2		3	3.2	1.8'–3.2' Clay, sandy at top, silty, dark grayish brown, mottled orange brn, moist
					0					4		3.2'–5.1' Clay, silty, light olive brown, mottled orange brn, moist
					0	moist		2.5Y 5/3		5	5.1	4.8'–5.3' E11-SU-MW1122A @ 1250
↓			5.0'	5.0'	0	wet	soft	2.5Y 4/3		6	6.2	5.1'–6.2' Sand, very fine grained, silty, olive brown, wet
					0	moist		10YR 4/2		7		6.2'–7.7' Clay, silty, brown, mottled black, orange brown, moist
7.8										8	7.7	7.7'–9.1' Sand very fine grained, silty, light olive brown, wet
					0	wet	soft	2.5Y 5/3		9	9.1	9.1'–11.7' Clay, sl. silty, mottled light bluish gray, dk brn, orange brn, moist
↓						moist		10YR 6/2		10		

NOTES:

EDITED BY/DATE:

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1122

SHEET 2 OF 2

PROJECT: EAKER AFB RFI

JOB NO.: 0114

BORING NO.: MW11

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.	
↓			5.0'	5.0'	0	moist	firm	2.5Y 5/2		11	11.7	
6.8										12		11.7'–17.9' Clay, sl. silty, grayish brn, mottled orange brn to reddish brn clay fractures.
										13		
										14		
										15		
										16		
										17		
										18		

NOTES: ______ EDITED BY/DATE: ______

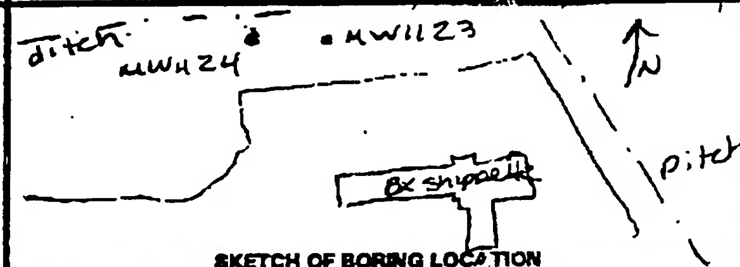
Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1123

SHEET 1 OF 2

PROJECT: EAKER AFB RFI	JOB NO.: 0114	BORING/WELL NO.: MW1123	
	LOGGED BY: G. Millar	TOTAL DEPTH OF BOREHOLE:	
DRILLING CONTRACTOR: Tri-State Testing		SURFACE ELEV.:	DATUM:
DRILLER'S NAME: John Crawford		START TIME: 15 35	DATE: 8/11/95
DRILL RIG TYPE: CME 75		FINISH TIME: 1730	DATE: 8/11/95
BORING METHOD: 7 1/4 HSA Overdrilled w/10" HSA		WATER DEPTH:	
HOLE DIAMETER: 10"		DATE:	
SAMPLING METHOD: Continuous Sampling		TIME:	
HAMMER WGT.: N/A	DROP HGT: N/A	BACKFILLED, TIME:	DATE:
SURFACE CONDITIONS: Grassy		WEATHER: Hot; Humid; 95° F, Sunny	



SKETCH OF BORING LOCATION

SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY	MATERIAL DESCRIPTION
.5 – 3	SS w/ liner	NA	3FT	3FT	0/0	slt moist	slt loose	10YR 3/4				0.5" – 3.0' – Sandy SILT; some Clay; dk yellowish brn; color change at 1.5' to 10YR 4/4 yellowish brn then back to 10YR 3/4 at 2 ft. sand is fg angular; well sorted. slt cohesive; multiple roots to 1.5' less roots to 3.0'.
					0/0			10YR 4/4		1	SM	
					0/0		slt soft	10YR 3/4		2		
3 – 8			5.0	2.5	0/0			10YR 6/4		3		3.0' – 8.0' – SILT; trace vfg sand; angular grains; trace Clay; yellowish brn; some root casts + roots; mottled w/10YR 4/6 dk yellowish brn; appears laminated
					4/0				EB-SS-MW1123A	4	ML	
										5, 6, 7		
8 –			5FT	3.5	0/0	SAT	v. soft	10YR 3/3		8	▼?	8.0' – 9.5' – SILT; trace sand; vfg; brn w/ 10YR 5/6 yellowish brn mottling.
					0/0	WET	soft			9, 10		

NOTES: ______ EDITED BY/DATE: ______

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1123

SHEET 2 OF 2

PROJECT: EAKER AFB RFI | JOB NO.: 0114 | BORING NO.: MW1123

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.	
					0/0	wet	soft					9.5' - 13.0' - Clayey SILT; trace vfg sand; brn. Some roots; root casts + worm burrows; mottled w/ 10YR5/6 yellowish brn; slt plastic
					0/					11		
										12		
13	CS w/ liner		5FT	5FT	/0	slt moist	slt stiff	10YR 5/2		13		13.0' - 15.0' - CLAY; trace silt; grayish brn w/ multiple root casts / worm burrows throughout; filled w/ 2.5YR4/6 dk red silty sand material. Some root structures still intact, some caliche; slt. plastic
					0/0					14	CL	
					0/0		stiff	10YR 4/1		15		
					0/0					16		
					0/0					17		
18			1.5	1.5	0/0					18		15.0' - 19.5 - CLAY; trace silt. dark gray; some worm burrows / root cast but not as many as 13.0-15.0'. Worm burrows filled w 2.5YR 4/6 dk red material; not plastic until ~ 19.0' when more silt is noted. No worm burrows / rootcasts below 18.0' but some caliche noted.
					0/		slt stiff			19		
										20		TD 19.5'

NOTES:

EDITED BY/DATE:

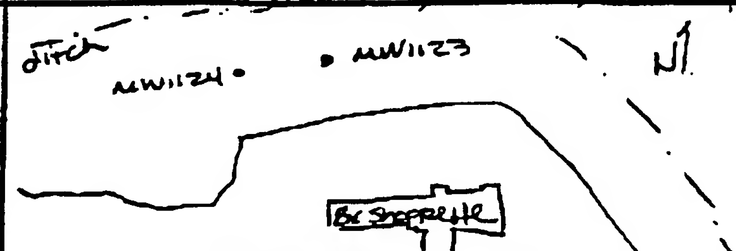
Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1124

SHEET ____ OF ____

PROJECT: EAKER AFB RFI	JOB NO.: 0114	BORING/WELL NO.: MW1124	
	LOGGED BY: G. Millar	TOTAL DEPTH OF BOREHOLE:	
DRILLING CONTRACTOR: Tri-State Testing		SURFACE ELEV.:	DATUM:
DRILLER'S NAME: John Crawford		START TIME: 0930	DATE: 8/12/95
DRILL RIG TYPE: CME-75		FINISH TIME: 1915	DATE: 8/12/95
BORING METHOD: 7¼ HSA overdrilled w/10" HSA		WATER DEPTH:	
HOLE DIAMETER: 10"		DATE:	
SAMPLING METHOD: Continuous Sampling		TIME:	
HAMMER WGT.: NA	DROP HGT: NA	BACKFILLED, TIME:	DATE:
SURFACE CONDITIONS: Grassy		WEATHER: Hot; Humid; 95°F; Sunny	



SKETCH OF BORING LOCATION

SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY
.5	CS w/ Liner	NA	5FT	4.5	0/0	Slt moist	Slt loose	10YR 3/4	NO SAMPLES COLLECTED		ML
					0/0		Loose	10YR 4/2		1	
					0/0		Soft	10YR 3/3, 10YR 3/2		2	SM / SP, ML
					0/0			10YR 3/2		3	ML
					0					4	thinly laminated
5			5FT	5FT	0/0	moist	soft			5	
					0/0					6	
					0/0	WET				7	
8	CS w/o Liner		5FT	5FT	0/0	WET	v/ soft			8	▽
					0/0	moist	slt soft	10YR 3/1		9	ML / OL

MATERIAL DESCRIPTION

.5' – 1.5' – Clayey SILT; Some Sand, fg, angular grains roots; dk yellowish brn.

1.5' – 2.3' – Sandy SILT; Some clay, Sl. Cohesive v.dk grayish brn.

2.3' – 2.5' – SAND; vfg; well sorted; angular; brn. laminated w/ yellowish brn. color.

2.5' – 4.5' – Clayey SILT Some muscovite, v.dk grayish brn. Color change @ 3.5' to grayish brn w/ 10YR 4/6 dk red mottleing.

4.5' – 9.0' – SILT, grayish brn.

NOTES: drilled to determine if contamination exists in the lower aquifer.

EDITED BY/DATE: ______ ______

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1124

SHEET ______ OF ______

PROJECT: EAKER AFB RFI

JOB NO.: 0114

BORING NO.: MW1124

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.
					0/0	moist	[illegible] soft	10YR 6/1		11	
					0/0					12	CL
13					0/0					13	
			5FT	5FT	0/0	sl. moist	sl. stiff			14	
					0/0		stiff	10YR 6/1		15	
					0/0					16	
					0/0					17	
18					0/0					18	
			5FT	5FT	0/0	moist; very moist	sl. soft			19	CH
					0/0					20	
					0/0					21	
					0/0					22	
23					0/0	moist				23	
			5FT	4.5	0/0					24	CL
					0/0					25	
					0/0					26	
					0/0	SAT	loose	10YR 5/4		27	
28					0/0					28	SW
	NC 2		10FT	10FT	0/0					29	
					0/0					30	

Sample number column (written vertically): NO SAMPLES COLLECTED FOR ANALYSIS

trace sand vfg; trace clay, more clay from 6.0' - to 6.3'; mottled throughout w/ dk yellowish brn; from 8.0'-9.0' more clay.

9.0' - 14.0' - SILTY CLAY, root casts; worm burrows; roots; some intact carbonized root structures; grey w/ 2.5YR 4/8 dk red; plastic

14.0' - 18.0' - Clay; trace silt dk gray, some vertical seams filled w/ 10YR 5/8 yellowish brn material. Some root casts + worm burrows. One verticle seam ~ 3 inches in length begins at ~16.0'

18' - 23.0' - Clay as above w/ more worm burrows; root casts verticle seams filled w/ 10YR 5/8 yellowish brn. One verticle seam extends from 21.5' - 22.5'. Horizontal vfg sandy/silt seam from 22.0' - 22.5'.

23.0' - 26.0' Sand/Silty CLAY; sand is med grained; angular; well sorted; dk grey w/ some 10YR 5/6 mottling; some very small root casts, or worm burrows.

26.0' - 38.0' - SAND; med grained sub angular; well sorted; qtz. yellowish brn.

NOTES: * Seven ft. of blowin at 28'.0ft.

EDITED BY/DATE: ________ ________

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1124

SHEET ______ OF ______

PROJECT: EAKER AFB RFI | JOB NO.: 0114 | BORING NO.: MW1124

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.	
	NA	NA	10FT	10FT	0/0	SAT	LOOSE	10YR 5/4				
					0/0					31		Continued drilling w/ 7¼ HSA to TD of 38' - No sampling from 28' - 38' - logged by cuttings.
					0/0					32	SW	
					0/0				NO SAMPLES COLLECTED FOR ANALYSIS	33		
					0/0					34		TD - 38'
					0/0					35		
					0/0					36		
					0/0					37		
S										38		

NOTES: ______

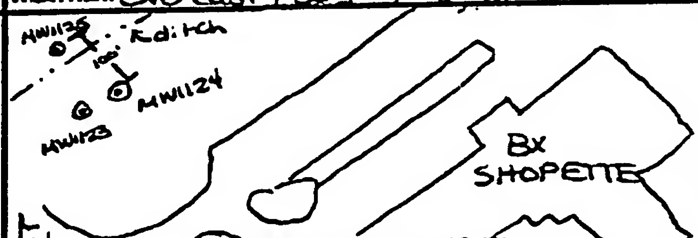
EDITED BY/DATE: ______

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1125
SHEET 1 OF 2

PROJECT: EAKER AFB RFI	JOB NO.: 0114	BORING/WELL NO.: MW1125	
	LOGGED BY: G. Millar	TOTAL DEPTH OF BOREHOLE: 28'	
DRILLING CONTRACTOR: Tri-State Testing		SURFACE ELEV.:	DATUM:
DRILLER'S NAME: John Crawford		START TIME: 0828	DATE: 10/31/95
DRILL RIG TYPE: CME-75		FINISH TIME: 0925	DATE: 11/01/95
BORING METHOD: 7¼" HSA Overdrilled w/10" HSA		WATER DEPTH:	
HOLE DIAMETER: 10"		DATE:	
SAMPLING METHOD: Continuous Sampling		TIME:	
HAMMER WGT.: NA	DROP HGT: NA	BACKFILLED, TIME:	DATE:
SURFACE CONDITIONS: Grassy		WEATHER: Overcast; 50's-70's; slt. breeze	



SKETCH OF BORING LOCATION

SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY	MATERIAL DESCRIPTION
NOT SAMPLED FOR LITHOLOGY OR ANALYSIS										0–18		See boring log for MW1124, drilled 8/12/95 for description of lithology from surface to 18.0'. Summary of lithology from surface to 18.0': 0.0'-1.5' - Clayey SILT; 1.5'-2.3' - Sandy SILT; 2.3'-2.5' - SAND; 2.5'-4.5' - Clayey SILT; 4.5'-9.0' - SILT; 9.0'-14.0' - Silty CLAY; 14.0'-18.0' - CLAY
18	CS w/ liner	NA	5FT	3FT	0/0	Vr. moist	Soft	10YR 5/2		18–20	CL	

NOTES: Drilled to determine extent of Contamination in groundwater.

EDITED BY/DATE:

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1125
SHEET 2 OF 2

PROJECT: EAKER AFB RFI | JOB NO.: 0114 | BORING NO.: MW1125

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.
23	[illegible]	NA	5FT	3FT	0/0	SH. MOIST	SH. STIFF	[illegible]		21, 22	CL
23			5FT	2.5	0/0	V. MOIST	SOFT			23, 24	CL
					0/0	SAT	LOOSE	[illegible]		25	SW
28					0/			[illegible]		26, 27, 28	SP
										29–38	

NO SAND DESCRIBED 28'/38' BASED ON SOIL CUTTINGS

18.0' - 20.0' - Silty CLAY; Clayey SILT; brn. W 10YR 5/6 yellowish brn. mottling; some root structures and worm burrows.

20.0' - 21.0' - CLAY; trace silt; dk gray; some brn 10YR 5/3 mottles; slt. plastic.

21.0' - 24.5' - Sandy CLAY, dk gray; sand is poorly sorted, some med. and some fg sand, angular; @ 24.0' is a 2 inch verticle sand seam. Sand is fg to med. grained 5YR 5/8 yellowish red and angular.

24.5' - 25.0' - SAND; well sorted fg sand; angular; gray.

25.0' - 25.5' - SAND; poorly sorted mg - fg; angular qtz; some coarse grains; multi colored grains; overall color 10YR 5/6 - yellowish brn.

25.5' - 28.0' - AS above

TD = ~~28.0~~ [initials] 12/5/95

TD = 38

NOTES:

EDITED BY/DATE:

SENT BY:BROWN AND ROOT,ENV ;12-21-95 ; 4:26PM ; → 13038318208;#15/21

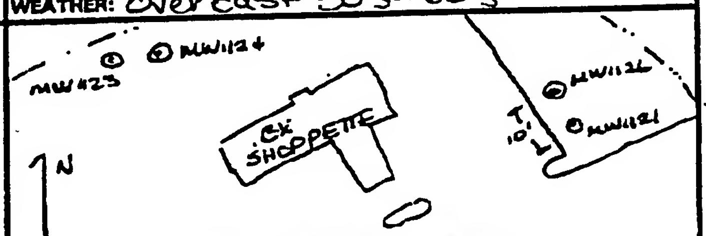
Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1126
SHEET 1 OF 2

PROJECT: EAKER AFB RFI	JOB NO.: 0114 LOGGED BY: G. Millar	BORING/WELL NO.: MW1126 TOTAL DEPTH OF BOREHOLE: ~~33.0'~~

DRILLING CONTRACTOR: Tri-State Testing	SURFACE ELEV.: DATUM:
DRILLER'S NAME: John Crawford	START TIME: 1027 DATE: 11/01/95
DRILL RIG TYPE: CME-75	FINISH TIME: 1900 DATE: 11/07/95 grouted
BORING METHOD: 7¼" HSA overdrilled w/ 10" HSA	WATER DEPTH:
HOLE DIAMETER: 10"	DATE:
SAMPLING METHOD: Continuous Sampling	TIME:
HAMMER WGT.: NA DROP HGT: NA	BACKFILLED, TIME: DATE:
SURFACE CONDITIONS: Grassy	WEATHER: Overcast 50's-60's



SKETCH OF BORING LOCATION

SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY	MATERIAL DESCRIPTION
NOT SAMPLED FOR LITHOLOGY OR ANALYSIS										0–18		See boring log for MW1121 for lithology from 0.0'-~~18.0'~~ 16.3'. Summary of MW1121 from 0.0'-~~18.0'~~ 16.3' is below:
												0.5'-1.1' - Sandy, Clayey, SILT
												1.1'-2.9' - SAND, fg.
												2.9'-4.0' - Silty CLAY.
												4.0'-13.8' - Silty CLAY.
												13.8'-16.3' - CLAY.
18	CS N/O [illegible]	NA	SST	3.3	0/0	[illegible]	[illegible]	10YR 4/1		18–20	CH	

NOTES: Drilled to determine presence or absence of contamination.

EDITED BY/DATE: [illegible] 11/28/95

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1126

SHEET 2 OF 2

PROJECT: EAKER AFB RFI

JOB NO.: 0114

BORING NO.: MW1126

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.	
	C.S. w/c Liner	NA	5FT		0/0	slt. mois	slt soft	10YR 5/3		21	CH	18.0'-20.3' - CLAY; slt. plastic dk gray; some root structures + worm burrows.
23										22		20.3'-21.3' - As above w/ color change to brn.
23			5FT	5FT	0/0	slt. mois	slt. stiff	10YR 4/1		23		
					0/0					24		23.0'-25.0' - CLAY; some sand; poorly sorted; angular, med; coarse, + fine grains, dk gray, slt. plastic, some root casts, worm burrows, veins filled w/ yellowish red silt; some 10YR 5/3 (brn), mottles.
					0/0					25		
					0/0					26	CL	
28					0/0					27		
28			5FT	5FT	0/0					28		25.0'-28.0' - Sandy CLAY; dk gray; angular; fg - coarse grained, veins filled w/ 10YR 5/8 yellowish red silt.
					0/0	SAT LEVEL				29		
					0/0					30	SM SP SW	
					0/0					31		28.0-29.2' - Sandy CLAY as above, sand is med grained to fine grained.
33										32		
										33		29.2 - 33.0' - SAND; med grained to fg, poorly sorted angular qtz w/ multi colored grains.
Not Sampled For Lithology Drilled By Hollow Stem Auger										41		TD = 41

~~TD = 33.0 (well installed at 41.0').~~ 11/28/95

- Thought to be sand based on drill cuttings and adjacent bore hole data.

NOTES: Due to proximity of adjacent holes & time limitations, a complete soil description not performed @ this location

EDITED BY/DATE: [illegible] 11/28/95

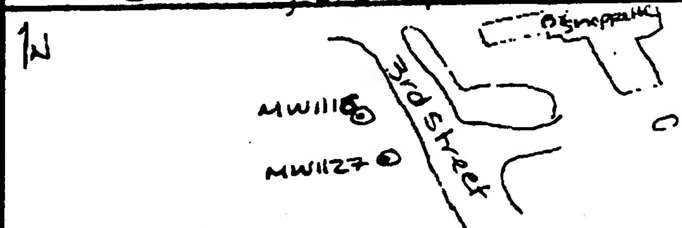
Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1127

SHEET 1 OF 2

PROJECT: EAKER AFB RFI	JOB NO.: 0114	BORING/WELL NO.: MW1127	
	LOGGED BY: G. Millar	TOTAL DEPTH OF BOREHOLE: 28.0'	
DRILLING CONTRACTOR: Tri-State Testing		SURFACE ELEV.:	DATUM:
DRILLER'S NAME: John Crawford		START TIME: 1634	DATE: 11/02/95
DRILL RIG TYPE: CME - 75		FINISH TIME: 1400	DATE: 11/08/95
BORING METHOD: 7 1/4" HSA Overdrilled w/10" HSA		WATER DEPTH:	
HOLE DIAMETER: 10"		DATE:	
SAMPLING METHOD: Continuous Sampling		TIME:	
HAMMER WGT.: NA	DROP HGT: NA	BACKFILLED, TIME:	DATE:
SURFACE CONDITIONS: Grassy		WEATHER: Overcast; breezy; 40's - 50's.	



SKETCH OF BORING LOCATION

SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY	MATERIAL DESCRIPTION
NOT SAMPLED FOR LITHOLOGY OR ANALYSIS												See boring log for MW1116 drilled 12/16/91 for lithology from ~~+8"~~ surface to 18.0'.
										2		
										4		
										6		
										8		
										10		
										12		
										14		
										16		
										18		
18	CS w/ Liner	NA	5FT	5FT	0ppm	dry moist – sl. moist	v. soft – sl. stiff	10YR 5/3 – 10YR 4/1			ML CL	18.0' – 19.0' - Silty CLAY / Clayey
										20	CL	SILT. multiple small root

NOTES: Drilled to determine the absence or presence of contamination in sand.

EDITED BY/DATE: LR Eller 11/28/95

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1127

SHEET 2 OF 2

PROJECT: EAKER AFB RFI | JOB NO.: 0114 | BORING NO.: MW1127

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.
	CS W/L LINR	NA	5FT	5FT	0PPM	Sli. Moist	Sli. Stiff			21	
										22	CL
23						moist	Sli. Soft			23	
23			5FT	3.8						24	
						SAT	LOOSE	10YR 4/1		25	SW
										26	
								10YR 5/3		27	SP
28										28	
										29	
										30	
										31	
										32	
										33	
										34	
										35	
										36	
36.5'										37	
										38	
										39	
										40	

NOT SAMPLED
LITHOLOGY FOR
DELINEATED W/ HOLLOW
STEM AUGER CENTER BIT

structures / worm burrows filled w/ 5YR 5/8 yellowish red material / overall color brn.

19.0' - 24.5' - CLAY, some SILT; root structures / worm burrows to 21.0' then less root structures but some 10YR 5/3 brn. mottles; some fg - mg, poorly sorted sand. Overall color dk gray.

24.5' - 26.0' - SAND; vfg - fg, well sorted; angular, dk gray; Peat-like material from 25.0' - 25.2' dk black.

26.0' - 28.0' - vfg - mg, SAND, ~~Well rnd.~~ poorly sorted, brn, angular grains, qtz.

TD = ~~28.0'~~ 36.5'

NOTES: DUE TO PROXIMITY OF HOLES & TIME LIMITATIONS, A COMPLETE SOIL DESCRIPTION NOT PERFORMED ~~[illegible]~~ @ THIS LOCATION.

EDITED BY/DATE: [signature]

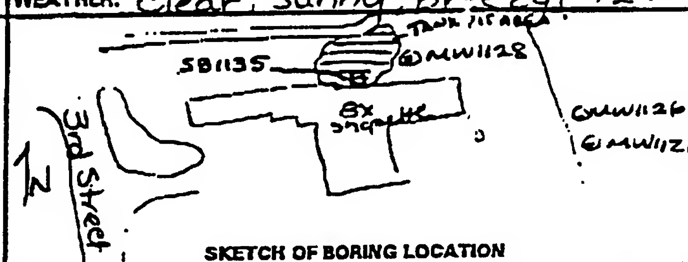
Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1128

SHEET 1 OF 3

PROJECT: EAKER AFB RFI	JOB NO.: 0114	BORING/WELL NO.: MW1128	
	LOGGED BY: G. Millar	TOTAL DEPTH OF BOREHOLE: 40.0'	
DRILLING CONTRACTOR: Tri-State Testing		SURFACE ELEV.:	DATUM:
DRILLER'S NAME: John Crawford		START TIME: 1525	DATE: 11/03/95
DRILL RIG TYPE: CME-75		FINISH TIME: 1800	DATE: 11/05/95
BORING METHOD: 7¼" HSA drilled through surface casing		WATER DEPTH:	
HOLE DIAMETER: 12" to 25'; 7¼" to 40.0'		DATE:	
SAMPLING METHOD: Continuous Sampling		TIME:	
HAMMER WGT.: NA	DROP HGT: NA	BACKFILLED, TIME:	DATE:
SURFACE CONDITIONS: Asphalt.		WEATHER: Clear; sunny; breezy; 42°F	



SKETCH OF BORING LOCATION

SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY	MATERIAL DESCRIPTION
NOT SAMPLED FOR ANALYSIS OR LITHOLOGY										1		surface to 10.0' not sampled for Lithology. See SB1135 for soil description in that interval.
										2		
										3		
										4		
										5		
										6		
										7		
										8		
										9		
										10		

NOTES: Drilled to determine presence or absence of contamination in the Sand aquifer.

EDITED BY/DATE: [signature] 11/28/95

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1128

SHEET 2 OF 3

PROJECT: EAKER AFB RFI | JOB NO.: 0114 | BORING NO.: MW1128

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.
10	CS W/O Liners	NA	3FT	3FT	.05/2000	Slt. moist	soft	10YR 5/2		11	ML
					4000/900					12	CL
13					60/56		slt. stiff	10YR 5/3		13	
13			5FT	5FT	70/15					14	
					20/15					15	CH
					20/15					16	
					20/15					17	
18					5			10YR 4/1		18	
18			5FT	4.5	.005/1CK	WET	slt. soft			19	
					10K/1CK					20	
					2000/1000	moist				21	
					1000/1000					22	
23					1000					23	
23			2FT	.5	15					24	
25										25	
25			3FT	3FT	0/0					26	
					0/0					27	
28					0/0	sat.	soft	10YR		28	
NOT SAMPLED										29	SP
										30	SW

10.0' – 11.0' – Clayey SILT; brownish gray, mottled w/ 10YR 5/3 brn. mottles.

11.0' – 12.5' – CLAY; some silt; brownish gray w/ some 10YR 5/6 yellowish brn. mottles. Some root casts, worm burrows; some roots still intact; slt. plastic

12.5' – 17.0' – CLAY, trace silt; plastic; brn. mottled w/ 10YR 5/6 yellowish brn. Root casts / worm burrows, some darker mottles, some intact roots.

17.0' – 25.0' – CLAY, some silt; dk gray; crumbly texture, verticle root casts w/ roots still intact; (some are 4-5 inches in length). Along root casts is yellowish red (iron) staining; some 10YR 5/3 brn. mottles; Product sheen observed in veins from 18.5' to 21.0'. Sheen also noted along barrell; Strong odor!

25.0' – 28.0 – CLAY; as above

28.0' – TD – SAND; fg-med grained poorly sorted w/ angular qtz; multi colored grains (wht, blk, coral); overall color brownish gray.

NOTES:

EDITED BY/DATE: [signature] 11/28/95

Halliburton NUS CORPORATION

FIELD LOG OF BORING

WELL NO. MW1128

SHEET 3 OF 3

PROJECT: EAKER AFB RFI | JOB NO.: 0114 | BORING NO.: MW1128

INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.	
												TD = 40.0'
										31		
										32		
										33		
										34		
										35		
										36		
										37		
										38		
										39		
										40		

NOT SAMPLED FOR LITHOLOGY OR ANALYSIS

NOTES: ______

EDITED BY/DATE: ______

Hole No. AP-62

DRILLING LOG	DIVISION MRD	INSTALLATION [illegible]	SHEET 1 OF 2 SHEETS
1. PROJECT ARMSTRONG STUDY BAKER AFB AR		10. SIZE AND TYPE OF BIT 10 1/4 bit	
2. LOCATION (Coordinates or Station) 5' from LIF 62		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USACE-CEMRK-EP-GG		12. MANUFACTURER'S DESIGNATION OF DRILL CME 750 / SCAPS	
4. HOLE NO. (As shown on drawing title and file number) OVERCORE AP-62		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER ROGER HUNTER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER NOT ENCOUNTERED	
		16. DATE HOLE	STARTED 18 OCT 95 / COMPLETED 18 OCT 95
		17. ELEVATION TOP OF HOLE	
7. THICKNESS OF OVERBURDEN —		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK —		19. SIGNATURE OF INSPECTOR Kathleen Olson	
9. TOTAL DEPTH OF HOLE 10.7			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–3.0		SANDY, CLAYEY FILL w/ gravel dk. gray to black petroleum odor 3.0			6 1/4" ID AUGER. Auger thru Asphalt + fill - No sample. SET UP ADJACENT to 231IF From 3-25-95. 3.0
	3.0–6.2		SILTY LEAN CLAY damp - moist mottled gray + orange V. STIFF; medium to stiff petroleum odor; becomes sandy w/ fine sand and moist to wet petroleum odor (heavy) stiff 6.2		4.2 GEOTECH FIELD TRAP 4.5	inserted INNER bbl sampler Ran 2.8 Rec 2.6 0.2 fell out of shoe. 5.8
	6.2–7.9		SILTY CLAY to clayey silt V. STIFF TO STIFF (breaks w/ pressure) cohesive moist gray + orange brown (dk brown areas when cut w/ knife - looks + smells like petroleum product) almost a sheen 7.9		7.4 Sample 7.8	Push probe 7.0' Auger 5' Rec 4.9'. made measurements from augered depth of 10.8'; one tenth
	7.9–9.2		SILT DARK GRAY; wet to SATURATED, medium CLAYEY, COHESIVE petroleum odor	9.2	8.1 sample 9.0	off of measurements made from tip of probe; 10.0 on auger = 10.1 on probe
	9.2–10		SILTY CLAY STIFF, MOIST GRAY + orange brown iron nodules		9.5 Sample 9.9	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT [illegible] HOLE NO.

Hole No. AP-62

DRILLING LOG	DIVISION MRD	INSTALLATION MPK	SHEET 2 OF 2 SHEETS

1. PROJECT: Armstrong Study EAKER AFB	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station): EAKER AFB	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY: USACE-CEMRK-EP-GG	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 750
4. HOLE NO. (As shown on drawing title and file number): AP-62	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: / UNDISTURBED:
5. NAME OF DRILLER: ROGER HUNTER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED: 18 OCT 95 — COMPLETED: 18 OCT 95
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR: Kathleen Olden

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			SILTY CLAY (continued)		10.5	
					FIELD	TRPH
					10.7	
	11					B.O.H @ 10.7
						11.28 → window
	12					
	13					13.33
						13.43
	14					Taped hole to 10.3' after augers out
	15					Note: MAY HAVE TO adjust all depths up 0.1'
	16					Samples 4.2-4.5 FIELD TRPH 7.4-7.8 / 8.7-9.0 / 9.5-9.9 { TPH, TRPH, PAH, FIELD TRPH, DISCRETE PAH 10.6-10.8 FIELD TRPH
	17					
	18					No water in hole on 20 OCT; hole backfilled with Concrete
	19					
	20					

ENG FORM ... | PROJECT | HOLE NO.

Hole No. AP-67

DRILLING LOG	DIVISION: MRD	INSTALLATION: MRK	SHEET 1 OF 1 SHEETS

1. PROJECT: ARMSTRONG VALID. STUDY
2. LOCATION (Coordinates or Station): EAKER AFB
3. DRILLING AGENCY: CEMRK-EP-GG
4. HOLE NO. (As shown on drawing title and file number): OVERCORE AP-67
5. NAME OF DRILLER: ROGER HUNTER
6. DIRECTION OF HOLE: ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 8.6
10. SIZE AND TYPE OF BIT: 10 1/4 auger bit 6" inner bbl sampler
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 750 / SCAPS
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED | UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER: NOT ENCOUNTERED
16. DATE HOLE: STARTED 19 OCT 95 | COMPLETED 19 OCT 95
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING %
19. SIGNATURE OF INSPECTOR: Kathleen Olson

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–3.0		No sample thru fill material — 3.0			6 1/4" ID Hollow STEM AUGERS — NS — 3.8
	3.0–4.2		SANDY FILL fine sand damp to moist, loose tan to black; wet; some blk fragments at base 4.2		3.8 / 3.9 SAMPLE 4.2	
	4.2–4.8		SILTY CLAY dark green gray moist med-stf 4.8		4.5	"
	4.8–7.0		SILTY CLAY gray & orange brown stf to v. stf; some f. sand; moist; some iron nodules; becomes more orange brown; becomes grayer 7.0		5.3 SAMPLE 5.5 / 5.8 SAMPLE 6.0 / 6.8 SAMPLE 7.0	AUGER 5.0 REC 5.0; made measurements from bottom up
	7.0–8.3		Silty clay V. STIFF, gray & orange brown with fine sand damp to moist 8.3		7.9 SAMPLE 8.3	
	8.3–8.6		clayey silt medium green gray moist to wet			taped to 8.6; B.O.H @ 8.6; on 20 OCT HOLE TAPED TO 7.9', no fluid encountered. Hole backfilled w/ Concrete

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE | PROJECT | HOLE NO.

Hole No. AP-63

DRILLING LOG	DIVISION MRD	INSTALLATION LAFB	SHEET 1 OF 1 SHEETS

1. PROJECT ARMSTRONG VALIDATION - LAKEY AFB	10. SIZE AND TYPE OF BIT 10¼" auger bit
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY CEMRK-EP-GG	12. MANUFACTURER'S DESIGNATION OF DRILL CME-750 / SCAPS & 6" inner bbl
4. HOLE NO. (As shown on drawing title and file number) OVERCORE AP-63	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER Roger Hunter	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER NOT ENCOUNTERED
	16. DATE HOLE STARTED 18 OCT 95 COMPLETED 18 OCT 95
7. THICKNESS OF OVERBURDEN —	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK —	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 8.7	19. SIGNATURE OF INSPECTOR Kathleen O'[illegible]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–3.8		SANDY FILL petroleum odor			Auger to 3.8' 3.8
	3.8–5.0		SILTY CLAY dk green gray to dk brown STIFF			START W/TIP OF PROBE AT 3.77 (3.8') PUSH PROBE, AUGER 5.0' Rec 4.2
	5.0	5.3	MOIST - wet petroleum odor	5.0		
		5.7	high angle sand layer blk material; oily appearance at top & bottom	5.7		
	5.7		SILTY CLAY gray & orange brown STIFF - VSTIFF MOIST			(petroleum odor throughout sample)
		6.6 6.8	SAND 0.07 looks like 0.2' blk at bottom blk may be flat particles		6.7 6.8 7.1	
	7.2		SAND 7.2		7.2	hole measured to 8.7; made measurements from bottom up
			SILTY CLAY to clay silt iron nodules orange brown & gray MOIST, STIFF - VSTIFF		7.5 7.9	
	8.1		- SAND 0.07 looks like 0.2' black at bottom contact	8.1		
			clayey silt dk greenish gray cohesive wet medium-soft some fine sand			8.7' EOH Probe 0.16' below sample
	10					No LIQUID IN HOLE @ END OF DAY, ABOUT 1.1' at end of 20 OCT; hole backfilled w/ Concrete

ENG FORM 1836 | PROJECT | HOLE NO.

Hole No. AD-63

DRILLING LOG	DIVISION MRD	INSTALLATION MRK	SHEET 1 OF 2 SHEETS

1. PROJECT ARMSTRONG VALID STUDY - EAKER	10. SIZE AND TYPE OF BIT 10 1/4" BIT & 6" INNER BBL
2. LOCATION (Coordinates or Station) EAKER AFB AR	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY MRK-ED-GG	12. MANUFACTURER'S DESIGNATION OF DRILL CME 750
4. HOLE NO. (As shown on drawing title and file number) OFFSET AD-63	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER ROGER HUNTER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER Not encountered
	16. DATE HOLE — STARTED 20 OCT 95 — COMPLETED 20 OCT 95
7. THICKNESS OF OVERBURDEN —	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK —	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 13.6	19. SIGNATURE OF INSPECTOR [illegible]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–4		(Fill)		4.0	NS 4.0
	4		black clay 4.2			
			SAND wet w/ product fine sand clayey, cohesive black		4.4	Run 1 6" split inner bbl sampler
	5	5.0	high angle contact	5.2	5.2	
			SAND yellow stained w/ black		5.3	Rec 4.6'
		5.7	5.7			
	6		SILTY CLAY AND SAND high angle to vertical contact, clay is gray & orange V. STIFF TO HARD		6.5	
					ANALYTICAL SAMPLE 7.0	
	7	7.1	has some root hairs or root structures			← FIELD TRPH OFF SCALE
		7.5	CLAY becomes SOFTER		7.5	
	8				8.4	← FIELD TRPH X3 8.6
			CLY SILT & sand GREEN GRAY COHESIVE, some f sand moist to wet adjacent to fine sand, tan, loose		8.6	[illegible] sand [illegible] black clay
	9				9.4	Run 2
			← SAT SILT; w/adj cont sand black streak		SILT SAMP	
					9.9	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT [illegible] HOLE NO.

Hole No. AD-63

DRILLING LOG	DIVISION MRD	INSTALLATION MRK	SHEET 2 OF 2 SHEETS
1. PROJECT Armstrong Validation Study		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) Eaker AFB, AR		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY CEMRK-EP-GG		12. MANUFACTURER'S DESIGNATION OF DRILL CME 750	
4. HOLE NO. (As shown on drawing title and file number) OFFSET AD-63		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER ROGER HUNTER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE	STARTED 20 OCT 95 / COMPLETED 20 OCT 95
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR K. OHMI, 01 Dec	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10.1		(AS ABOVE)	10.1		Run 2
		CLAY CHANGES BUT CONTACT w/ sand is VERTICAL THROUGHOUT INTERVAL	STIFF CLAY silty, iron nod (small) sat → wet, H gray green & orange	10.6		RAN 5 REC 5
	11		SAND & SILTY CLAY Sand & Clay are side by side. Sand is stained w/ black. SILTY/CLAY is SOFT, SATURATED predominanty green gray, some orange brown → STIFF - V. STF, WET	11.9	12 0	
	12		FAT CLAY / FINE SAND WET, STIFF STICKY Some silt gray w/ orange brown petroleum odor black hair like organic or root matter iron nodules (small)		12 A	
	13		FINE SAND - SAT, petroleum odor turns green when dry ; loose adjacent to clay. clay becomes more orange brown w/ depth			13.6
						B.O.H

NOTE: SAND TURNS GREENISH UPON drying ; can see staining along vertical & high angle pathways.

Free product entered hole - approximately 3.0' at end of day. Hole backfilled with concrete.

Fuel sample sent to lab for fuel ID.

Hole No. AD-68

DRILLING LOG	DIVISION MRD	INSTALLATION MRK	SHEET 1 OF 1 SHEETS

1. PROJECT: ARMSTRONG VALIDATION EAKER AFB
2. LOCATION (Coordinates or Station): EAKER AFB AP. - GAS STATION
3. DRILLING AGENCY: CEMRK-EP-GG
4. HOLE NO. (As shown on drawing title and file number): OFFSET AD 68
5. NAME OF DRILLER: ROGER HUNTER
6. DIRECTION OF HOLE: ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: —
8. DEPTH DRILLED INTO ROCK: —
9. TOTAL DEPTH OF HOLE: 8.6
10. SIZE AND TYPE OF BIT: 10 1/4" auger Bit
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 750 w/ 6 1/4" ID Hollow Stems
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED | UNDISTURBED
14. TOTAL NUMBER CORE BOXES:
15. ELEVATION GROUND WATER: NOT ENCOUNTERED
16. DATE HOLE: STARTED 20 OCT 95 | COMPLETED 20 OCT 95
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: Keith Leon Olsen

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–3.6		(Fill)			NS
	3.6					3.6
	3.7	3.7	SANDY CLAY crumbly texture petroleum odor dk brown to blk VSTIFF TO STIFF, moist w/ wet surfaces	3.7	3.8 ANALYTICAL 4.0	6" inner bbl RAN 5.0 REC 5.0
			- becomes mottled w/ orange brown & grayer (lighter in color) and V.STIFF, crumbly 5.0		4.5 ANALYTICAL	
	5.0		SILTY CLAY TO CLY SILT gray & orange brown medium moist w/ wet surfaces white root hairs. crumbly structure w/ fine sand	5.8	5.8 GEOTECH SAMPLE 6.1	5.5-6.0 ANALYTICAL SAMPLE 6.0-6.5 (?)
	6.5	6.5	SILT w/ CLAY some fine sand, dk gray medium wet to sat some iron staining -> mottled w/ increase in clay 7.2		6.5: ANALYTICAL 7.0	
	7.2		SILT, clayey green gray, sdy, med, moist to wet 7.6		7.2 GEOTECH SAMPLE	7.5-8.0 ANALYTICAL SAMPLE
	7.6	7.9	SILT, clayey - clay w/ fine white root hairs STIFF, becomes darker gray -> becomes sandy		7.6	
	8.6					tape to 8.6 B.O.H.
						No WATER IN HOLE @ end of day, backfilled w/ concrete

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT | HOLE NO.

Hole No. AP-67

DRILLING LOG	DIVISION MRD	INSTALLATION MRK	SHEET 1 OF 1 SHEETS

1. PROJECT: Armstrong Study Eaker AFB, AR	10. SIZE AND TYPE OF BIT: 10¼ auger bit / 10" inner bbl
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY: USACE-CEMRK-EP-GS	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 750 / SCAPS
4. HOLE NO. (As shown on drawing title and file number): OVERCORE AP-68	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
5. NAME OF DRILLER: ROGER HUNTER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: NOT ENCOUNTERED
	16. DATE HOLE: STARTED 19 OCT 95, COMPLETED 19 OCT 95
	17. ELEVATION TOP OF HOLE
7. THICKNESS OF OVERBURDEN: —	18. TOTAL CORE RECOVERY FOR BORING %
8. DEPTH DRILLED INTO ROCK: —	19. SIGNATURE OF INSPECTOR: [illegible]
9. TOTAL DEPTH OF HOLE: 10'	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–2.9		No Sample. 2.9			No fluid in hole on 20 OCT; bottom taped at 8.1 hole back filled w/ concrete. NOTE: USED TAPE CHECK OF 9.8 AND made measurements from bottom up; window was 0.3' below shoe when removed from hole. REC 1.9
	3		SAND DAMP, FINE, GRAY to black FILL 3.4			
	4		SILTY CLAY STIFF, DAMP to moist DARK GRAY 4.3			
	5		CLAYEY SILT medium, cohesive MOIST DARK GREEN GRAY; SOFT, WET, IRON STAINED 5.5			tape to 4.8 5.0'
	6		SILTY CLAY some sand V. STIFF MOIST Lt Gray + orange brown some iron stained + iron nodules 7.0		5.8; FILL TE; 5.9; 6.0; 6.5	INSERTED PROBE, tip at 5.5, pushed 6.4, tip finishes at 11.9 about 0.3' below shoe. REC 4.9
	7		CLY SILT w/ f. sand, cohesive greenish gray w/ some iron STAIN MOIST, STIFF - V STIFF 7.8		7.8	FIELD TECH FAN TECH (SPOILS) 8.0 8.2
	8		SILTY CLAY - CLY SILT STIFF, MOIST gray w/ orange brown mottles 8.5		8.5	
	9		CLAYEY SILT cohesive, greenish gray wet, stiff → becomes saturated, medium		8.8; 9.5; FIELD TECH; 9.8	(probe may have slipped when removed from hole) tape to 9.8 [illegible]
	10		B.O.H			

ENG FORM [illegible] | PROJECT | HOLE NO.

WELL INSTALLATION LOGS

BX SHOPPETTE

Source: Halliburton NUS 1992 and 1995.

NUS CORPORATION

FIELD WELL COMPLETION FORM TW1101

JOB NAME: EAKER AFB BX SHOPETTE

JOB NUMBER: 3K98 | PROJECT MANAGER: GVG

LOGGED BY: JSB | EDITED BY: bFR

WELL NAME: TW1101 | DATE: 12/11/91

DRILLING COMPANY: A.W. POOL

EQUIPMENT: ☒ 6 1/4 INCH HOLLOW STEM AUGER | DRILLER: V. BARAZZA

☐ ______ INCH ROTARY WASH | HOURS DRILLED: 1

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: PRESSURE STEAM

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

3 100# SACKS OF COLORADO SILICA 20/40 SAND

______ SACKS OF ______ CEMENT

~20 GALLONS OF GROUT USED (PORTLAND TYPE II w/BENTONITE)

______ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

~15 FEET OF 2 INCH PVC BLANK CASING

~10 FEET OF 2 INCH PVC SLOTTED SCREEN

[illegible]

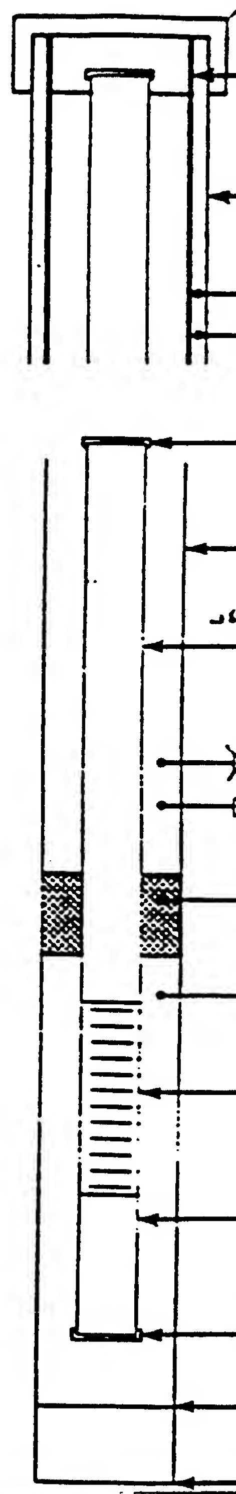
______ YARD[illegible] ORDERED

______ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☐ YES

NAME ______

WELL COVER USED: ☐ LOCKING STEEL COVER ☒ CHRISTY BOX ☐ OTHER ______



☒ CHRISTY BOX

☐ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

6 1/4 INCH DIAMETER BOREHOLE 0 to 30 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT 0.2' FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 30 feet

JSB ~~4~~ 2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.2 to 15.2 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 11 to 0.5 feet

BENTONITE PELLET SEAL 12.5 to 11 feet

COLORADO SILICA 20/40 (NAME) (NUMBER) SAND PACK 30 to 12.5 feet

2 INCH DIAMETER SLOTTED 0.006 INCH SCREEN 15.2 to 25.2 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 25.2 to 27.2 feet

BOTTOM WELL CAP 27.2 feet

HOLE CLEANED OUT TO 30 feet

BOTTOM OF BOREHOLE [illegible]

ADDITIONAL INFORMATION:

NOTE: MATERIALS WERE NOT MEASURED BEFORE GOING IN WELL JSB

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB BX

JOB NUMBER: 3K98 | PROJECT MANAGER: GVG

LOGGED BY: JSB | EDITED BY: BFH

WELL NAME: T:v11 02 | DATE: 12-11-91

DRILLING COMPANY: A W POOL

EQUIPMENT: ☒ 6 1/4 INCH HOLLOW STEM AUGER ☐ ____ INCH ROTARY WASH | DRILLER: V. BARAZZA | HOURS DRILLED: .68

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: PRESSURE STEAM

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

3.5 SACKS OF SILICA GRADE SAND

____ SACKS OF ____ CEMENT

~20 GALLONS OF GROUT USED (PORTLAND TYPE II w/ BENTONITE)

____ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

12.4 FEET OF 2 INCH PVC BLANK CASING

~~10.2 FEET OF 2 INCH PVC SLOTTED SCREEN~~

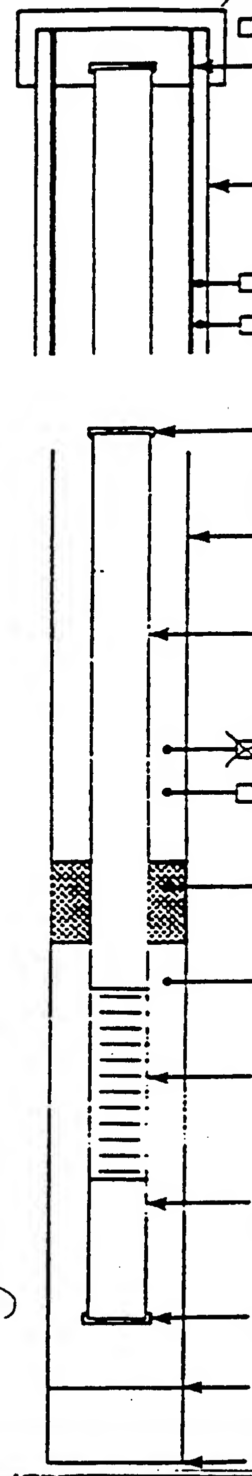
~~YARD³ CEMENT-SAND (REDI-MIX) ORDERED~~

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☐ YES

NAME ____

WELL COVER USED: ☐ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☒ CHRISTY BOX

☐ LOCKING STEEL COVER

__–__ INCH DIAMETER STEEL CONDUCTOR CASING __–__ to __–__ feet

__–__ INCH DIAMETER BOREHOLE __–__ to __–__ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL __–__ to __–__ feet

TOP OF CASING AT 0.1 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4" INCH DIAMETER BOREHOLE 0 to 30 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.1 to 12.4 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 11 to ~0.5 feet

BENTONITE PELLET SEAL 9 to 11 feet

(NAME) (NUMBER) SAND PACK 11 to 27.7 feet

2 INCH DIAMETER SLOTTED 0.06 INCH SCREEN 12.4 to 22.6 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 22.6 to 27.7 feet

BOTTOM WELL CAP 27.7 feet

HOLE CLEANED OUT TO 30 feet

BOTTOM OF BOREHOLE

NOT TO SCALE

ADDITIONAL INFORMATION:

Borehole caved in ~2' prior to setting well

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB BX			
JOB NUMBER: 3K98	PROJECT MANAGER: GVG		
LOGGED BY: JSB	EDITED BY: BFN		
WELL NAME: TW1103	DATE: 12/11/91		
DRILLING COMPANY: AW POOL			
EQUIPMENT: ☒ 6¼ INCH HOLLOW STEM AUGER ☐ ____ INCH ROTARY WASH	DRILLER: V. BARAZZA HOURS DRILLED: 1		
GALLONS OF WATER USED DURING DRILLING: NONE GALLONS			
METHOD OF DECONTAMINATION PRIOR TO DRILLING: PRESSURE STEAM			

DEVELOPMENT
SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:		
DEVELOPMENT BEGAN DATE:	TIME:	
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS
DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT:	☐ CLEAR ☐ MOD. TURBID	☐ SLIGHTLY CLOUDY ☐ VERY MUDDY
ODOR OF WATER:		
WATER DISCHARGED TO:	☐ GROUND SURFACE ☐ STORM SEWERS ☐ DRUMS	☐ TANK TRUCK ☐ STORAGE TANK ☐ OTHER ____
DEPTH TO WATER AFTER DEVELOPMENT:		FEET

MATERIALS USED

2.5 SACKS OF Silica Grade SAND

____ SACKS OF ____ CEMENT

____ GALLONS OF GROUT USED

____ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

15 FEET OF 2 INCH PVC BLANK CASING

10 FEET OF 2 INCH PVC SLOTTED SCREEN

[illegible]

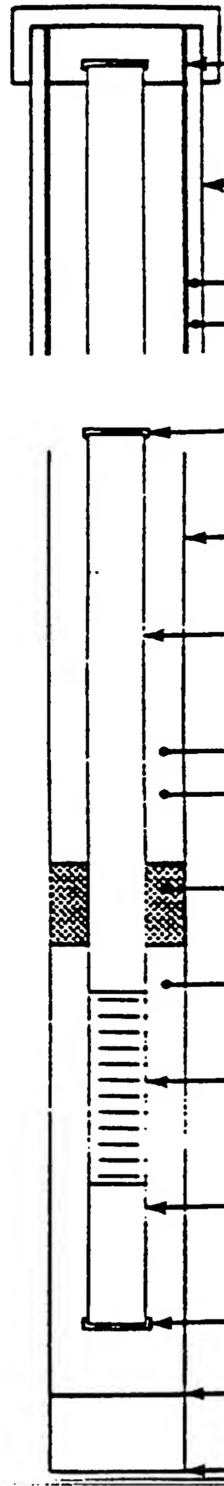
____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☐ YES

NAME ____

WELL COVER USED: ☐ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

____ INCH DIAMETER STEEL CONDUCTOR CASING ____ to ____ feet

____ INCH DIAMETER BOREHOLE ____ to ____ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

TOP OF CASING AT 0.1 FEET ABOVE AT BELOW GROUND LEVEL

6¼ INCH DIAMETER BOREHOLE 0 to 30 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.1 to 15.1 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

BENTONITE PELLET SEAL 11 to 13 feet

(NAME) (NUMBER) SAND PACK 13 to 30 feet

2 INCH DIAMETER SLOTTED (0.010 inch) SCREEN 15.1 to 25.1 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 25.1 to 27.1 feet

BOTTOM WELL CAP 27.1 feet

HOLE CLEANED OUT TO 30 feet

BOTTOM OF BOREHOLE [illegible]

NOT TO SCALE

ADDITIONAL INFORMATION:

WELL ABANDONED 1/8/92

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB

JOB NUMBER: 3K98 | PROJECT MANAGER: GVG

LOGGED BY: BFN | EDITED BY: BFN

WELL NAME: TW1104 | DATE: 12-11-91

DRILLING COMPANY: A.W. POOL

EQUIPMENT: ☒ 6 1/4 INCH HOLLOW STEM AUGER | DRILLER: V. BARBAZZA

☐ ______ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: none GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: pressure steam

DEVELOPMENT see DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ______

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

2.5 SACKS OF Silica Grade SAND

______ SACKS OF ______ CEMENT

~20 GALLONS OF GROUT USED (PORTLAND TYPE I w/BENTONITE)

______ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

14 FEET OF 2 INCH PVC BLANK CASING

10 FEET OF 2 INCH PVC SLOTTED SCREEN

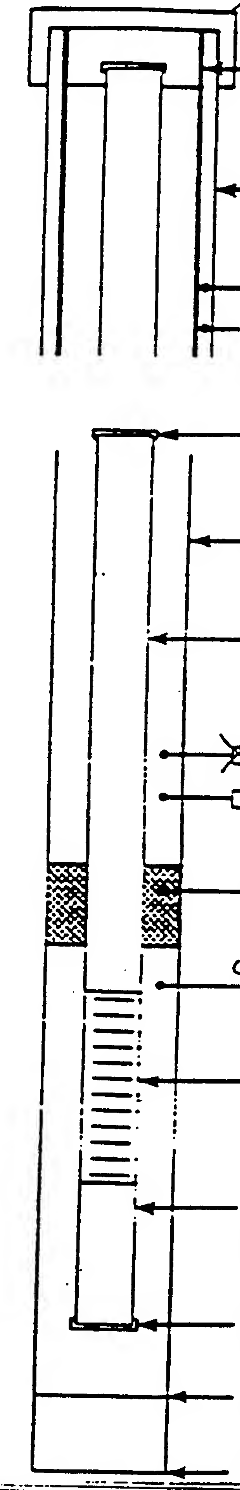
YARD CEMENT-SAND (REDI-MIX) ORDERED

YARD CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ______

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ______



☒ CHRISTY BOX

☐ LOCKING STEEL COVER

___ INCH DIAMETER STEEL CONDUCTOR CASING ___ to ___ feet

___ INCH DIAMETER BOREHOLE ___ to ___ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ___ to ___ feet

TOP OF CASING AT 0.1 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 30 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.1 to 14.1 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 10 to ~0.5 feet

BENTONITE PELLET SEAL 10 to 12 feet

COLORADO SILICA 20/40 (NAME) (NUMBER) SAND PACK 12 to 30 feet

2 INCH DIAMETER SLOTTED 0.01 INCH SCREEN 14.1 to 24.1 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 24.1 to 26.1 feet

BOTTOM WELL CAP 26.1 feet

HOLE CLEANED OUT TO 30 feet

BOTTOM OF BOREHOLE 30

NOT TO SCALE

ADDITIONAL INFORMATION: ______

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB	
JOB NUMBER: 3K98	PROJECT MANAGER: GVG
LOGGED BY: BFN	EDITED BY: BFN / JSB
WELL NAME: E11TW05	DATE: 12/13/91
DRILLING COMPANY: Pool Drilling	
EQUIPMENT: ☐ 6 1/4 INCH HOLLOW STEM AUGER ☐ ____ INCH ROTARY WASH	DRILLER: V. Burrazza HOURS DRILLED: 46

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam cleaned

DEVELOPMENT

SEE LOGBOOK; WELL CONTAINS FREE

METHOD OF DEVELOPMENT: PRODUCT; WAS NOT DEVELOPED

DEVELOPMENT BEGAN DATE: TIME:

YIELD	TIME	DATE
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☒ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

2.5 SACKS OF SILICA Grade 20/40 SAND

____ SACKS OF ____ CEMENT

~20 GALLONS OF GROUT USED (PORTLAND TYPE II CEMENT / BENTONITE)

____ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

13.1 FEET OF 2 INCH PVC BLANK CASING

10 FEET OF [illegible]

2.1 [illegible]

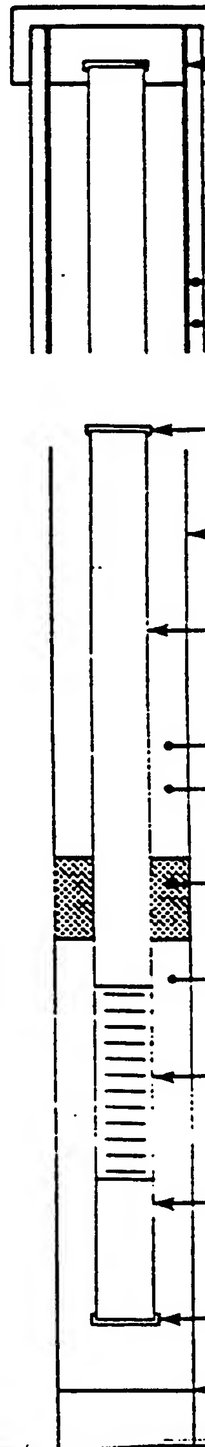
____ YARD^3 CEMENT-SAND (REDI-MIX) ORDERED

____ YARD^3 CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT 0.3 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 25 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.3 to 13.4 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 9 to 0.5 feet

BENTONITE PELLET SEAL 9 to 11 feet

COLORADO SILICA (NAME) (NUMBER) SAND PACK 11 to 25.5 feet

2 INCH DIAMETER SLOTTED 0.010 INCH SCREEN 13.4 to 23.4 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 23.4 to 25.5 feet

BOTTOM WELL CAP 25.5 feet

HOLE CLEANED OUT TO 25.5 feet

[illegible] 25.5 [illegible]

NOT TO SCALE

ADDITIONAL INFORMATION: ____

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Eaker AFB

JOB NUMBER: 3K98 | PROJECT MANAGER: George Gartseff

LOGGED BY: LRE | EDITED BY: BFN

WELL NAME: E11TW06 | DATE: 12/13/91

DRILLING COMPANY: Pool Drilling

EQUIPMENT: ☐ 6 1/4 INCH HOLLOW STEM AUGER | DRILLER: V. Barrazza

☐ ______ INCH ROTARY WASH | HOURS DRILLED: 1.2

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: High-pressure steam

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ______

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

3.5 SACKS OF 20/40 SAND

______ SACKS OF ______ CEMENT

~20 GALLONS OF GROUT USED (CEMENT/BENTONITE)

– SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

13.20 FEET OF 2 INCH PVC BLANK CASING

10.20 FEET OF [illegible]

2.00 FEET OF 2 [illegible]

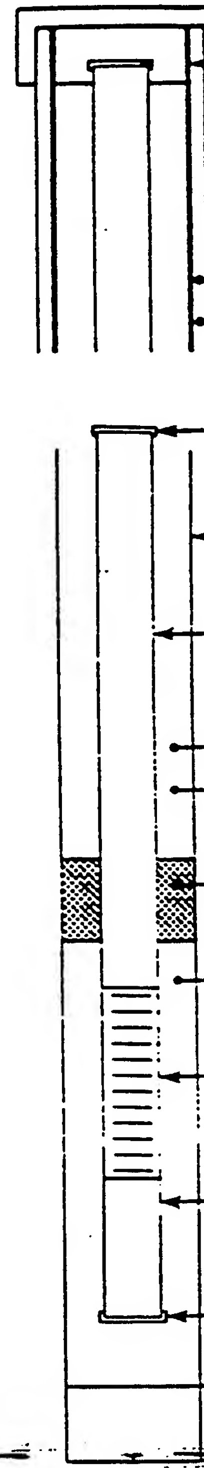
______ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

______ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ______

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ______



☐ CHRISTY BOX

☒ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT -0.3 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE +0.0 to 29 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING -0.3 to -13.50 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 11 to ~0.5 feet

BENTONITE PELLET SEAL 9 to 11 feet

Colorado Silica 20/40 (NAME) (NUMBER) SAND PACK 11 to 29 feet

2 INCH DIAMETER SLOTTED: .006 inch SCREEN -13.50 to -23.70 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP -23.70 to -25.70 feet

BOTTOM WELL CAP -25.70 feet

HOLE CLEANED OUT TO — feet

[illegible] -29 feet

NOT TO SCALE

ADDITIONAL INFORMATION: ______

NUS CORPORATION

FIELD WELL COMPLETION FORM

SITE NAME: EAKER AFB			
JOB NUMBER: 3K98		PROJECT MANAGER: GVG	
LOGGED BY: JRE		EDITED BY: CFN	
WELL NAME: E11TW07			DATE: 12/13/91
DRILLING COMPANY: A.W. POOL			
EQUIPMENT: ☒ ~~7¼~~ 6¼ JSS 3/31/92 INCH HOLLOW STEM AUGER; ☐ ____ INCH ROTARY WASH			DRILLER: V. BARRAZZO; HOURS DRILLED: 0.75

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: PRESSURE STEAM

DEVELOPMENT SEE DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD:	TIME:		DATE:
GPM	FROM	TO	
GPM	FROM	TO	
GPM	FROM	TO	
GPM	FROM	TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☒ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

2½ SACKS OF Colo. Silica 20/40 SAND

____ SACKS OF ____ CEMENT

____ GALLONS OF GROUT USED

____ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

14.92' FEET OF 2 INCH PVC BLANK CASING

10.08' ~~14.92~~ FEET OF 2 INCH PVC SLOTTED SCREEN

2.00' [illegible]

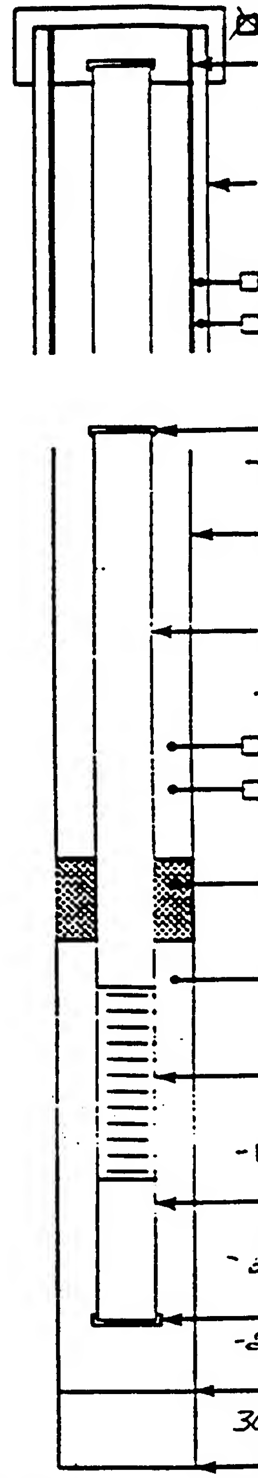
____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☒ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT -0.15 FEET ABOVE AT BELOW GROUND LEVEL

7¼ INCH DIAMETER BOREHOLE 0 to 30 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING -0.15 to 15.07 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

BENTONITE PELLET SEAL 11 to 13 feet

Colorado 20/40 (name) (number) SAND PACK 13 to 27 feet

2 INCH DIAMETER SLOTTED (0.006 (slot) SCREEN -15.07 to 25.15 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP -25.15 to 27.15 feet

BOTTOM WELL CAP -27.15 feet

HOLE CLEANED OUT TO 30 ~~27~~ feet

BOTTOM OF BOREHOLE 30 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

~~WEFS 8'~~ CFN

WELL ABANDONED 1/8/92

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Eaker AFB	
JOB NUMBER: 3K98	PROJECT MANAGER: GJG
LOGGED BY: LRE	EDITED BY: BFN
WELL NAME: EIITW1108	DATE: 12/14/91
DRILLING COMPANY: A.W. Pool	
EQUIPMENT: ☐ ~~7 1/2~~ 6 1/4 INCH HOLLOW STEM AUGER ☐ ____ INCH ROTARY WASH	DRILLER: V. Barrazzo HOURS DRILLED: 0.75
GALLONS OF WATER USED DURING DRILLING: None GALLONS	
METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam (High Pressure)	

DEVELOPMENT See well development form

METHOD OF DEVELOPMENT:		
DEVELOPMENT BEGAN DATE:	TIME:	
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS
DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT:	☐ CLEAR ☐ MOD. TURBID	☐ SLIGHTLY CLOUDY ☐ VERY MUDDY
ODOR OF WATER:		
WATER DISCHARGED TO:	☐ GROUND SURFACE ☐ STORM SEWERS ☐ DRUMS	☐ TANK TRUCK ☐ STORAGE TANK ☐ OTHER
DEPTH TO WATER AFTER DEVELOPMENT:		FEET

MATERIALS USED

2.5 SACKS OF Silica Grade SAND

____ SACKS OF ____ CEMENT

____ GALLONS OF GROUT USED

____ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

8.00 FEET OF 2 INCH PVC BLANK CASING

15.00 FEET OF 2 INCH PVC SLOTTED SCREEN

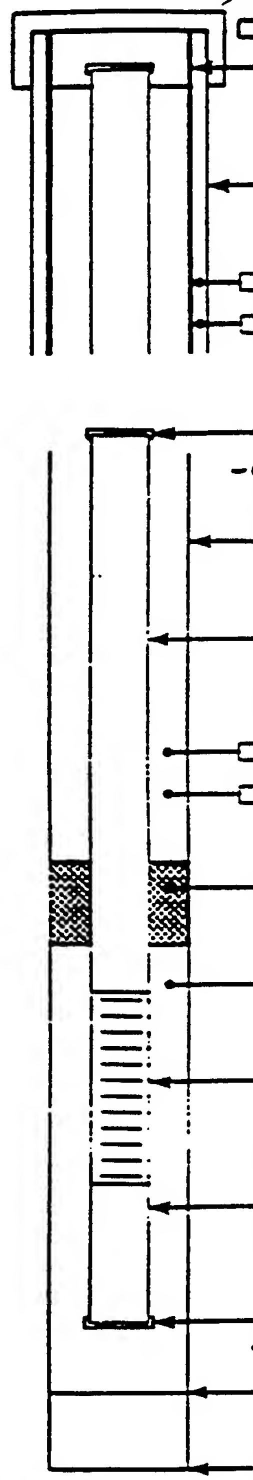
____ YARD³ CEMENT ...

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☒ CHRISTY BOX

☐ LOCKING STEEL COVER

____ INCH DIAMETER STEEL CONDUCTOR CASING ____ to ____ feet

____ INCH DIAMETER BOREHOLE ____ to ____ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

TOP OF CASING AT -0.2 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 29 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.2 to 8.20 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

BENTONITE PELLET SEAL 4 to 6 feet

Colo. Silica 20/40 (NAME) (NUMBER) SAND PACK 6 to 25 feet

2 INCH DIAMETER SLOTTED (.006 inch) SCREEN 8.20 to 23.20 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 23.20 to 25.20 feet

BOTTOM WELL CAP 25.20 feet

HOLE CLEANED OUT TO 25 feet

BOTTOM OF BOREHOLE 29 feet

NOT TO SCALE

ADDITIONAL INFORMATION: Well materials pulled on 12-18-91 Full recovery on well screen & riser. Borehole backfilled with 2.50 sal

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME:	EAKER AFB		
JOB NUMBER:	3K98	PROJECT MANAGER:	GVG
LOGGED BY:	LRE	EDITED BY:	BFN
WELL NAME:	E11TW1109	DATE:	12/14/91
DRILLING COMPANY:	A.W. POOL		
EQUIPMENT:	☒ 6¼ INCH HOLLOW STEM AUGER ☐ ____ INCH ROTARY WASH	DRILLER:	V. BARRAZZO
		HOURS DRILLED:	~~.50~~ 0.25 BFN
GALLONS OF WATER USED DURING DRILLING:	NONE	GALLONS	
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	HIGH PRESSURE STEAM		

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD:	TIME:		DATE:
GPM	FROM	TO	
GPM	FROM	TO	
GPM	FROM	TO	
GPM	FROM	TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

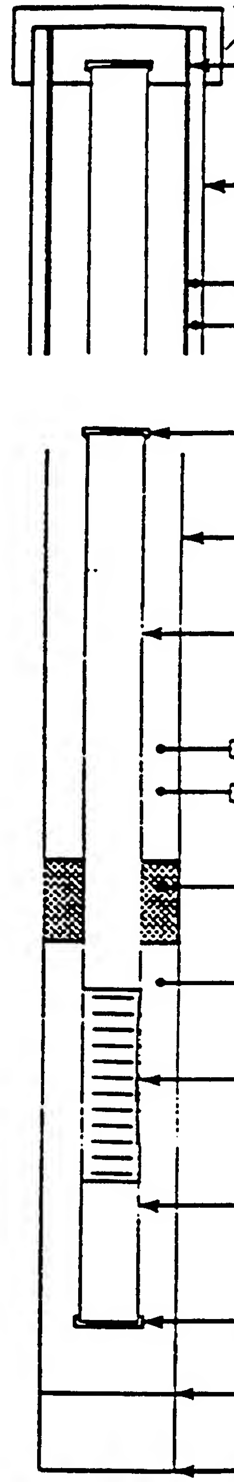
MATERIALS USED

- 2.5 SACKS OF COLORADO SILICA 20/40 SAND
- ____ SACKS OF ____ CEMENT
- ____ GALLONS OF GROUT USED
- ____ SACKS OF POWDERED BENTONITE
- 50 POUNDS OF BENTONITE PELLETS
- 8.00 FEET OF 2 INCH PVC BLANK CASING
- 10.00 FEET OF 2 INCH PVC SLOTTED SCREEN
- 2.00 FEET OF [illegible]
- ____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED
- ____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☒ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT -0.2 FEET ~~ABOVE AT~~ BELOW GROUND LEVEL

6¼ INCH DIAMETER BOREHOLE 0 to 25 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING -0.2 to 8.20 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

BENTONITE PELLET SEAL 4 to 6 feet

Colorado Silica (NAME) 20/40 (NUMBER) SAND PACK 6 to 22 feet

2 INCH DIAMETER SLOTTED (.006 INCH) SCREEN 8.20 to 18.20 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 18.20 to 20.20 feet

BOTTOM WELL CAP 20.20 feet

HOLE CLEANED OUT TO 22 feet

BOTTOM OF BOREHOLE 25 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

Bore Hole caved in 3'

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME:	EAKER		
JOB NUMBER:	3K98	PROJECT MANAGER:	GVG
LOGGED BY:	LRE	EDITED BY:	BFN
WELL NAME:	E11TW1110	DATE:	12/14/91
DRILLING COMPANY:	A W POOL		
EQUIPMENT:	☒ 6 1/4 INCH HOLLOW STEM AUGER	DRILLER:	V. BARRAZZA
	☐ ____ INCH ROTARY WASH	HOURS DRILLED:	.55

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: HIGH PRESSURE STEAM

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

2.5 SACKS OF Silica Grade SAND

____ SACKS OF ____ CEMENT

~5 GALLONS OF GROUT USED (CEMENT/BENTONITE)

____ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

8.00 FEET OF 2 INCH PVC BLANK CASING

10.00 FEET OF 2 INCH PVC SLOTTED SCREEN

2.00 FEET OF 2 [illegible]

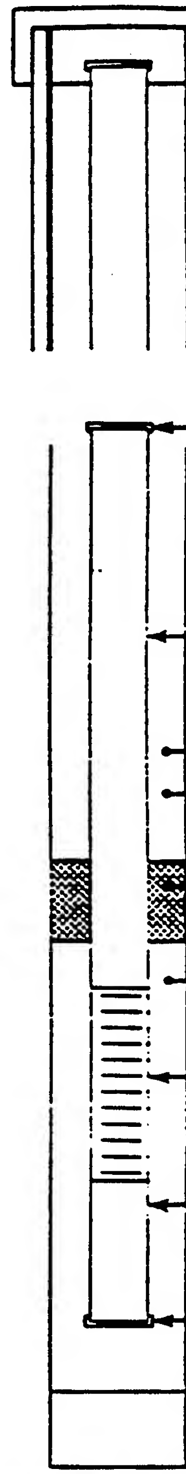
____ YARD³ CEMENT-SAND (REDI-MIX) [illegible]

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER



☐ CHRISTY BOX

☒ LOCKING STEEL COV[ER]

— INCH DIAMET[ER] STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT -0.2 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 25 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING -0.20 to -8.20 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 4 to ~0.5 feet

BENTONITE PELLE[T] SEAL 4 to 6 feet

Colorado Silica 30/40 (name) (number) SAND PACK 6 to 22 feet

2 INCH DIAMETER SLOTTED (.006 inch) SCREEN -8.20 to -18.20 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP -18.20 to -20.20 feet

BOTTOM WELL CAP — feet

HOLE CLEANED OUT TO 22 feet

BOTTOM OF BOREHOLE 25 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB

JOB NUMBER: 3K98 | PROJECT MANAGER: GVG

LOGGED BY: BFK | EDITED BY: JSB

WELL NAME: E11TW1111 | DATE: 12-15-91

DRILLING COMPANY: Pool

EQUIPMENT: ☐ 6 1/4 INCH HOLLOW STEM AUGER | DRILLER: V. Barrazza

☐ ____ INCH ROTARY WASH | HOURS DRILLED: .42

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: HIGH PRESSURE STEAM

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

2.5 SACKS OF Silica Grade SAND

____ SACKS OF ____ CEMENT

~5 GALLONS OF GROUT USED (CEMENT/BENTONITE MIX)

____ SACKS OF POWDERED BENTONITE

25 POUNDS OF BENTONITE PELLETS

8 FEET OF 2 INCH PVC BLANK CASING

10 FEET OF 2 INCH PVC SLOTTED SCREEN

[illegible]

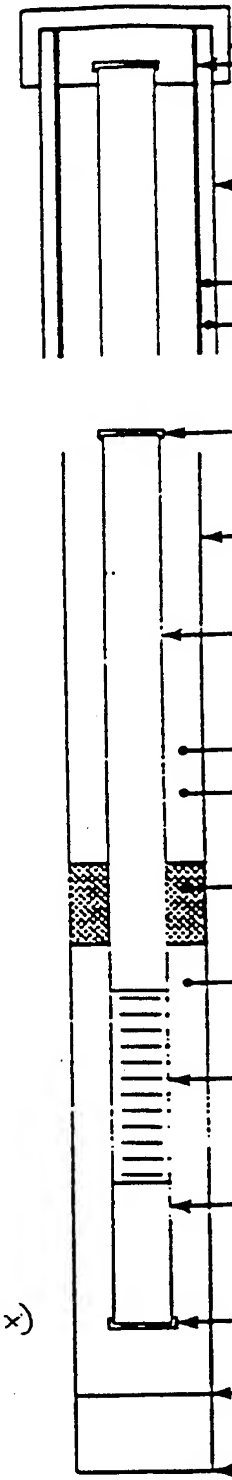
____ YARD [illegible] (REDI-MIX) ORDERED

____ YARD [illegible] USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER
☐ CHRISTY BOX
☐ OTHER ____



☐ CHRISTY BOX

☒ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT 0.1 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 22 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.1 to 8.1 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 5.5 to ~0.5 feet

BENTONITE PELLET SEAL 5.5 to 6.5 feet

Colorado Silica 20/ (NAME) (NUMBER) SAND PACK 6.5 to 22 feet

2 INCH DIAMETER SLOTTED (0.006 inch) SCREEN 8.1 to 18.1 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 18.1 to 20.1 feet

BOTTOM WELL CAP 20.1 feet

HOLE CLEANED OUT TO: 22 feet

BOTTOM OF BOREHOLE 22

NOT TO SCALE

ADDITIONAL INFORMATION: ____

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB

JOB NUMBER: 3K98 | PROJECT MANAGER: GVG

LOGGED BY: BFW | EDITED BY: JSB

WELL NAME: EMW112 | DATE: 12-15-91

DRILLING COMPANY: Pool Drilling

EQUIPMENT: ☐ 6 1/4 INCH HOLLOW STEM AUGER ☐ ____ INCH ROTARY WASH | DRILLER: V. Barrazza | HOURS DRILLED: 1.25

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam cleaned

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

3.5 SACKS OF SILICA GRADE SAND

____ SACKS OF ____ CEMENT

____ GALLONS OF GROUT USED

____ SACKS OF POWDERED BENTONITE

25 POUNDS OF BENTONITE PELLETS

8 FEET OF 2 INCH PVC BLANK CASING

15 FEET OF 2 INCH PVC SLOTTED SCREEN

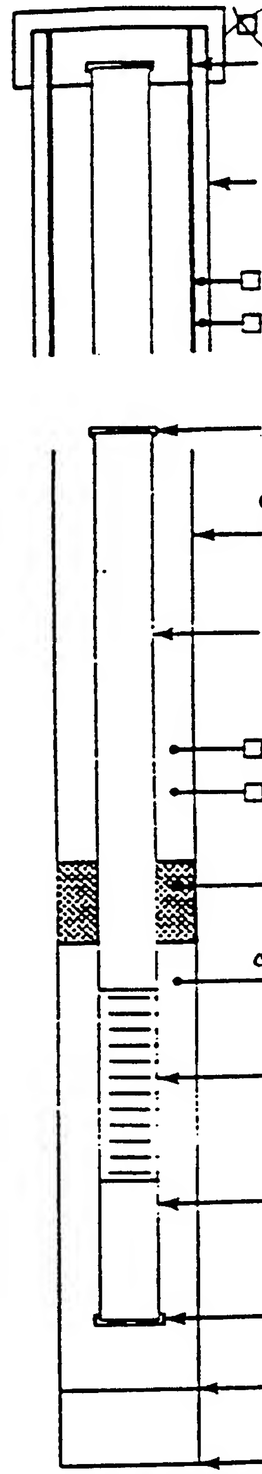
____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



ADDITIONAL INFORMATION:

Material was pulled & Grouted to Surface, on 1 full recovery of well screen & riser

NUS CORPORATION

FIELD WELL COMPLETION FORM

NAME: EAKER AFB			
JOB NUMBER: 3K98		PROJECT MANAGER: GVG	
LOGGED BY: LRE		EDITED BY: BFN	
WELL NAME: E11TW1113		DATE: 12/15/91	
DRILLING COMPANY: A W POOL			
EQUIPMENT: ☒ 6 1/4 INCH HOLLOW STEM AUGER ☐ ___ INCH ROTARY WASH		DRILLER: V. BARAAZA	HOURS DRILLED: 1
GALLONS OF WATER USED DURING DRILLING: 30 GALLONS			
METHOD OF DECONTAMINATION PRIOR TO DRILLING: HIGH PRESSURE STEAM			

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:			
DEVELOPMENT BEGAN DATE:	TIME:		
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS	
DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT:	☐ CLEAR ☐ MOD. TURBID	☐ SLIGHTLY CLOUDY ☐ VERY MUDDY	
ODOR OF WATER:			
WATER DISCHARGED TO:	☐ GROUND SURFACE ☐ STORM SEWERS ☐ DRUMS	☐ TANK TRUCK ☐ STORAGE TANK ☐ OTHER ___	
DEPTH TO WATER AFTER DEVELOPMENT:		FEET	

MATERIALS USED

2 SACKS OF COLORADO 20/40 SAND

– SACKS OF ___ CEMENT

– GALLONS OF GROUT USED

– SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

8.2 FEET OF 2 INCH PVC BLANK CASING

14.9 FEET OF 2 INCH PVC SLOTTED SCREEN

[illegible]

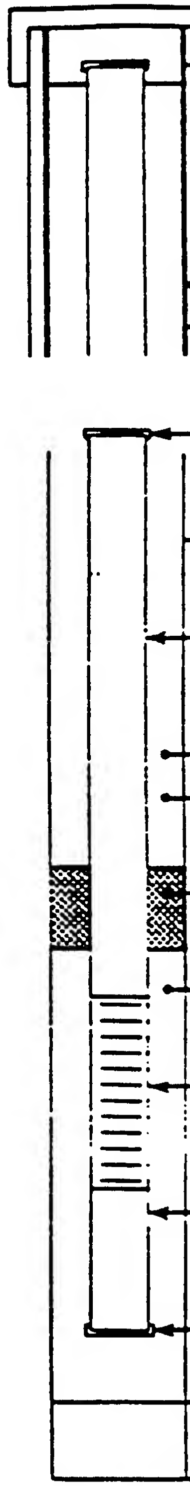
___ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

___ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ___

WELL COVER USED: ☒ LOCKING STEEL COVER (NONE USED JSB 3/31/92)
☐ CHRISTY BOX
☐ OTHER ___



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

– INCH DIAMETER STEEL CONDUCTOR CASING – to – feet

– INCH DIAMETER BOREHOLE – to – feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL – to – feet

TOP OF CASING AT 0.15 FEET (ABOVE) AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 27 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.15 to 8.35 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL – to – feet

BENTONITE PELLET SEAL 6 to 4 feet

COLORADO SILICA 20/40 (NAME) (NUMBER) SAND PACK 6 to 25.25 feet

2 INCH DIAMETER SLOTTED 0.006 (IN.) SCREEN 8.35 to 23.25 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 23.25 to 25.25 feet

BOTTOM WELL CAP 25.25 feet

HOLE CLEANED OUT TO 25.25 feet

BOTTOM OF BOREHOLE 27

NOT TO SCALE

ADDITIONAL INFORMATION:

Materials pulled, well grouted to the surface

12/18/91 JSB

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB

JOB NUMBER: 3K98 | PROJECT MANAGER: GVG

LOGGED BY: URE | EDITED BY: BFN

WELL NAME: E11TW1114 | DATE: 12/16/91

DRILLING COMPANY: A.W POOL

EQUIPMENT: ☐ 6 1/4 INCH HOLLOW STEM AUGER | DRILLER: V. BARRAZA

☐ ______ INCH ROTARY WASH | HOURS DRILLED: 1

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: STEAM CLEANED

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD:	TIME:	DATE:
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ______

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

2 SACKS OF Colorado Silica 20/40 SAND

______ SACKS OF ______ CEMENT

~2 GALLONS OF GROUT USED (CEMENT/BENTONITE

______ SACKS OF POWDERED BENTONITE

100 POUNDS OF BENTONITE PELLETS

6.1 FEET OF 2 INCH PVC BLANK CASING

10.2 FEET OF 2 INCH PVC SLOTTED SCREEN

2.00'

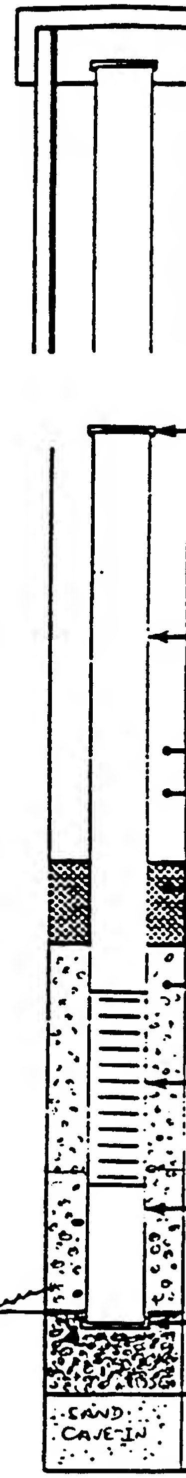
______ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

______ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ______

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ______



☒ CHRISTY BOX

☒ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT -0.1 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 24 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING -0.1 to 6.2 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 2 to -0.5 feet

BENTONITE PELLET SEAL * 2 to 4 feet

Colorado 20/40
(NAME) (NUMBER)
SAND PACK 4 to 18 feet

2 INCH DIAMETER SLOTTED 0.006 INCH SCREEN 6.2 to 16.4 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 16.4 to 18.4 feet

BENTONITE PELLET SEAL

BOTTOM WELL CAP 18.4 feet

HOLE CLEANED OUT TO 22 feet

BOTTOM OF BOREHOLE 24 feet

NOT TO SCALE

ADDITIONAL INFORMATION: * ALSO, BENTONITE SEAL FROM 18'-22'

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME:	EAKER AFB		
JOB NUMBER:	31C98	PROJECT MANAGER:	GJG
LOGGED BY:	LRE	EDITED BY:	BFN
WELL NAME:	E11TW1115	DATE:	12/16/91
DRILLING COMPANY:	A.W. POOL		
EQUIPMENT:	☐ 6 1/4 INCH HOLLOW STEM AUGER	DRILLER:	V. BARRAZA
	☐ ____ INCH ROTARY WASH	HOURS DRILLED:	1.0
GALLONS OF WATER USED DURING DRILLING:	NONE	GALLONS	
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	HIGH PRESSURE STEAM		

DEVELOPMENT SEE DEVELOPMENT FORM

METHOD OF DEVELOPMENT:			
DEVELOPMENT BEGAN DATE:		TIME:	
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
YIELD: GPM	TIME: FROM	TO	DATE:
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS	
DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT:	☐ CLEAR ☐ MOD. TURBID	☐ SLIGHTLY CLOUDY ☐ VERY MUDDY	
ODOR OF WATER:			
WATER DISCHARGED TO:	☐ GROUND SURFACE ☐ STORM SEWERS ☐ DRUMS	☐ TANK TRUCK ☐ STORAGE TANK ☐ OTHER ____	
DEPTH TO WATER AFTER DEVELOPMENT:		FEET	

MATERIALS USED

____ SACKS OF Colorado Silica 20/40 SAND

____ SACKS OF ____ CEMENT

2 GALLONS OF GROUT USED (CEMENT/BENTONITE)

____ SACKS OF POWDERED BENTONITE

25 POUNDS OF BENTONITE PELLETS

6.15 FEET OF 2 INCH PVC BLANK CASING

10.1 FEET OF 2 INCH PVC SLOTTED SCREEN

[illegible]

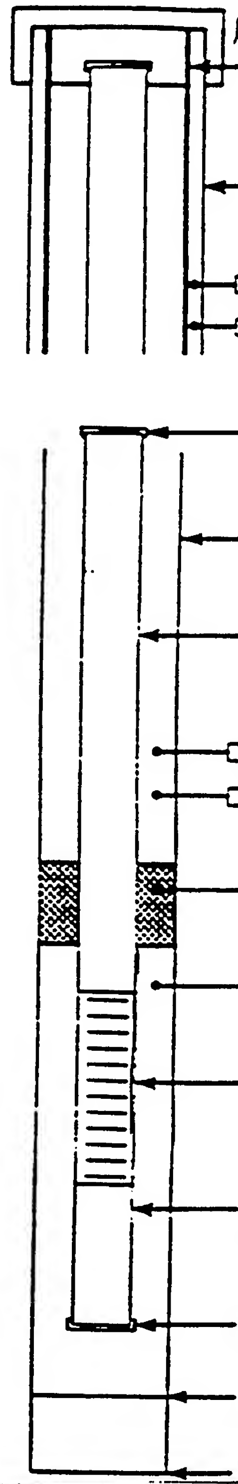
____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☒ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT -0.1 FEET ABOVE AT BELOW GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE -0.1 to 21 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING -0.1 to 6.2 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ~0.5 to 2 feet

BENTONITE PELLET SEAL * 2 to 4 feet

Colorado Silica 20/40 (NAME) (NUMBER) SAND PACK 4 to 18 feet

2 INCH DIAMETER SLOTTED (0.006 inch) SCREEN 6.2 to 16.3 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 16.3 to 18.3 feet

BOTTOM WELL CAP 18.3 feet

HOLE CLEANED OUT TO 21 feet

BOTTOM OF BOREHOLE 21

NOT TO SCALE

ADDITIONAL INFORMATION: PELLETS 18-21 TO SEAL OFF LOWER WATER ZONE

NUS CORPORATION

JOB NAME:	EAKER AFB
JOB NUMBER: 3K98	PROJECT MANAGER: GNG
LOGGED BY: LRE	EDITED BY: BGN
WELL NAME: ~~EH Flutter~~ JSB TWille	DATE: 12/16/91
DRILLING COMPANY:	
EQUIPMENT: ☒ 6 1/4 INCH HOLLOW STEM AUGER; ☐ ___ INCH ROTARY WASH	DRILLER: V. Barazza; HOURS DRILLED: 0.5
GALLONS OF WATER USED DURING DRILLING: — GALLONS	
METHOD OF DECONTAMINATION PRIOR TO DRILLING: HIGH PRESSURE STEAM	

DEVELOPMENT

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD:	TIME:	DATE:
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

3 SACKS OF 20/40 COLORADO SILICA SAND

___ SACKS OF ____ CEMENT

4 GALLONS OF GROUT USED (CEMENT/BENTONITE MIX)

___ SACKS OF POWDERED BENTONITE

25 POUNDS OF BENTONITE PELLETS

10 FEET OF 2 INCH PVC BLANK CASING

10.1 FEET OF 2 INCH PVC SLOTTED SCREEN 2.3' cut off

[illegible]

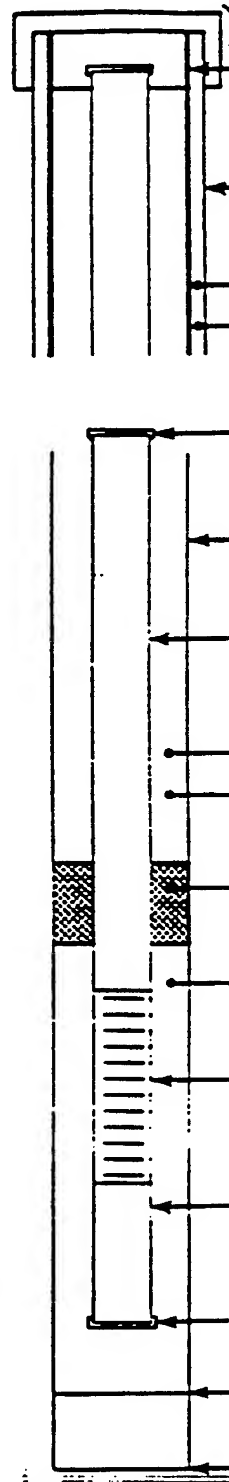
___ YARD^3 CEMENT-SAND (REDI-MIX) ORDERED

___ YARD^3 CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☒ LOCKING STEEL COVER

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

— INCH DIAMETER BOREHOLE — to — feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL — to — feet

TOP OF CASING AT 0.2 FEET ABOVE AT (BELOW) GROUND LEVEL

6 1/4 INCH DIAMETER BOREHOLE 0 to 22 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.2 to 7.9 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 5.5 to 0.5 feet

BENTONITE PELLET SEAL 7 to 5.5 feet

COLORADO SILICA (NAME) (NUMBER) SAND PACK 7 to 17 feet

2 INCH DIAMETER SLOTTED 0.006 inch SCREEN 7.9 to 18.0 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 18 to 20 feet

BOTTOM WELL CAP 20 feet

HOLE CLEANED OUT TO 22 feet

BOTTOM OF BOREHOLE

NOT TO SCALE

ADDITIONAL INFORMATION: Screen was originally set from 9.4 - 19.5 feet well was pulled up 1.5' and completed 12/17/91

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB	
JOB NUMBER: 3K98	PROJECT MANAGER: GVG
LOGGED BY: LRE	EDITED BY: BFN
WELL NAME: E11-TW119	DATE: 12/17/91
DRILLING COMPANY: A W POOL	
EQUIPMENT: ☒ 6¼ INCH HOLLOW STEM AUGER ☐ ____ INCH ROTARY WASH	DRILLER: V. BARRAZA HOURS DRILLED: 1
GALLONS OF WATER USED DURING DRILLING: NONE GALLONS	
METHOD OF DECONTAMINATION PRIOR TO DRILLING: PRESSURE STEAM	

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD	TIME	DATE
GPM	FROM TO	DATE:
GPM	FROM TO	DATE:
GPM	FROM TO	DATE:
GPM	FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

3 SACKS OF COLORADO SILICA 20/40 SAND

____ SACKS OF ____ CEMENT

~1 GALLONS OF GROUT USED (CEMENT/BENTONITE MIX)

____ SACKS OF POWDERED BENTONITE

25 POUNDS OF BENTONITE PELLETS

BENTONITE SEAL 17-18'

4.8 FEET OF 2 INCH PVC BLANK CASING

10.0 FEET OF 2 INCH PVC SLOTTED SCREEN

[illegible]

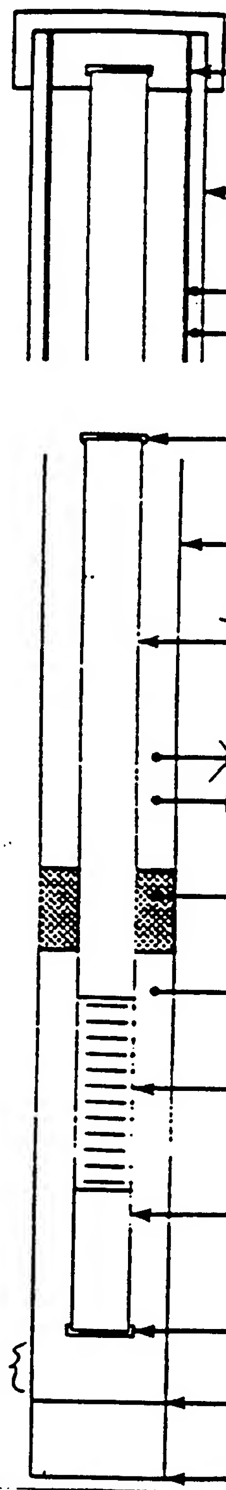
____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME ____

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☒ LOCKING STEEL COVER

____ INCH DIAMETER STEEL CONDUCTOR CASING ____ to ____ feet

____ INCH DIAMETER BOREHOLE ____ to ____ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

TOP OF CASING AT 0.2 FEET ABOVE AT BELOW GROUND LEVEL

6¼ INCH DIAMETER BOREHOLE 0 to 22 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0.2 to 5 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 2 to 0.5 feet

BENTONITE PELLET SEAL 2 to 3 feet

COLORADO SILICA 20/40 (NAME) (NUMBER) SAND PACK 3 to 17 feet

2 INCH DIAMETER SLOTTED 0.006 INCH SCREEN 15 to 5 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 15 to 17 feet

BOTTOM WELL CAP 17 feet

HOLE CLEANED OUT TO 20 feet

BOTTOM OF BOREHOLE

NOT TO SCALE

ADDITIONAL INFORMATION: ____

NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: EAKER AFB BX Shopette

JOB NUMBER: 3K98 | PROJECT MANAGER: GVG

LOGGED BY: JSB | EDITED BY: BFN

WELL NAME: TW1120 | DATE: 1-7-92

DRILLING COMPANY: A W POOL

EQUIPMENT: ☒ 6 1/4 INCH HOLLOW STEM AUGER | DRILLER: V. BARAZZA

☐ ______ INCH ROTARY WASH | HOURS DRILLED: .88

GALLONS OF WATER USED DURING DRILLING: NONE GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: PRESSURE STEAM

DEVELOPMENT SEE WELL DEVELOPMENT FORM

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM | TIME: FROM TO | DATE:

YIELD: GPM | TIME: FROM TO | DATE:

YIELD: GPM | TIME: FROM TO | DATE:

YIELD: GPM | TIME: FROM TO | DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

2 100# SACKS OF COLORADO SILICA 20/40 SAND

______ SACKS OF PORTLAND TYPE II CEMENT

______ GALLONS OF GROUT USED

______ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS

20 FEET OF 2 INCH PVC BLANK CASING

10 FEET OF 2 INCH PVC SLOTTED SCREEN

2 FEET OF 2 INCH PVC SUMP.

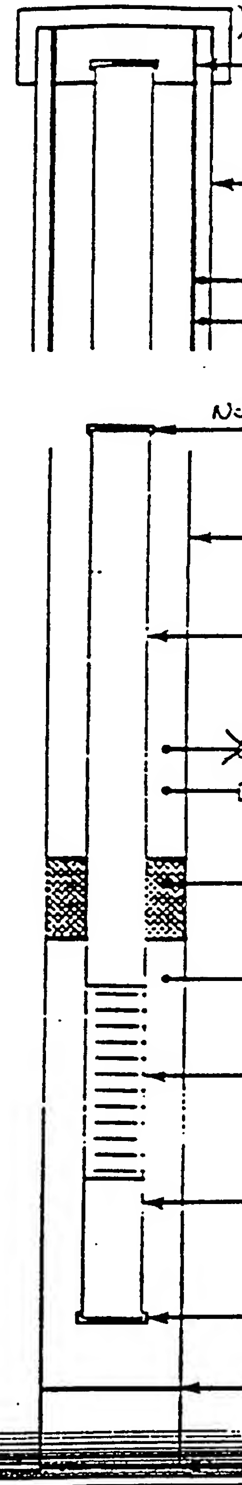
______ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

______ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ______



☐ CHRISTY BOX

☒ LOCKING STEEL CO

— INCH DIAMETER STEEL CONDUCTOR CASING — to — feet

6 1/4 INCH DIAMETER BOREHOLE 0 to 30 feet

☐ BENTONITE-CEMENT SEAL OR ☐ B-SACK CEMENT-SAND SEAL — to — feet

Note: STICK DOWN ~0.2

TOP OF CASING AT 1/4, +2.8 FEET ABOVE AT BELOW GROUND LEVE

6 1/4 INCH DIAMETER BOREHOLE 0 to 30 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 2.8 to 17.2 feet

☒ BENTONITE-CEMENT SEAL OR ☐ B-SACK CEMENT-SAND SEAL 0.5 to 15 feet

BENTONITE PELLET SEAL 15 to 16 feet

COLORADO SILICA (name) SAND PACK 20/40 (number) 30 to 16 feet

2 INCH DIAMETER SLOTTED 0.006 INCH SCREEN 17.2 to 27.2 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 27.2 to 29.2 feet

BOTTOM WELL CAP 29.2 feet

HOLE CLEANED OUT TO 30 feet

BOTTOM OF BOREHOLE 30 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

WELL PAD WAS CONSTRUCTED 1/9/92 - CUT OFF ~3.0' OF RISER PIPE, COMPLETED WELL AT FLUSH MOUNT

Halliburton NUS CORPORATION

FIELD WELL COMPLETION FORM

SITE NAME: Eaker AFB

JOB NUMBER: 0114 | PROJECT MANAGER: A Jenkins

LOGGED BY: RPH | EDITED BY: H Ellis

WELL NAME: MW1121 | DATE: 4/8/95

DRILLING COMPANY: Tri-State Testing

EQUIPMENT: ☑ 7¼ ID INCH HOLLOW STEM AUGER | DRILLER: Joe Haggs
☐ ______ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: NA GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam Cleaner

DEVELOPMENT See Well Development Form

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD:	TIME:	DATE:
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION TURBIDITY END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

DEPTH TO WATER AFTER DEVELOPMENT: FEET

JH

MATERIALS USED

11 SACKS OF 50lb 20/40 Morie SAND

______ SACKS OF ______ CEMENT

______ GALLONS OF GROUT USED

______ SACKS OF POWDERED BENTONITE

75 POUNDS OF BENTONITE PELLETS

1.8(+) 4.95 FEET OF 2 INCH PVC BLANK CASING

10.0 FEET OF 2 INCH ~~PVC~~ 5.S. SLOTTED SCREEN

2.0 feet of 2" S.S. silt trap

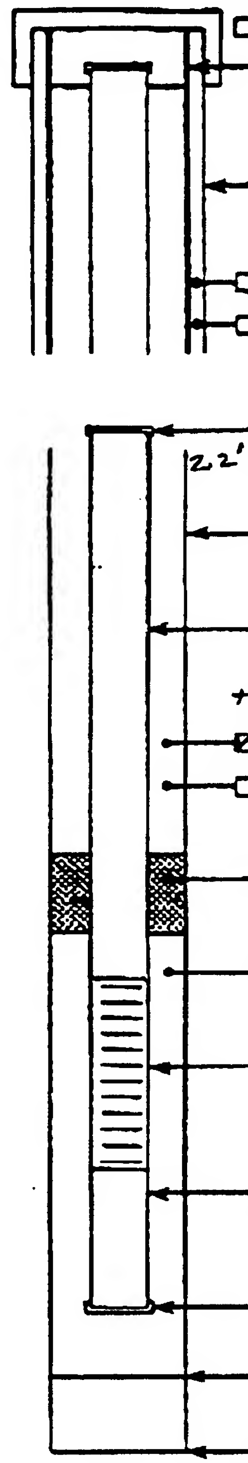
______ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

______ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☐ YES

NAME ______

WELL COVER USED: ☐ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ______



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

______ INCH DIAMETER STEEL CONDUCTOR CASING ______ to ______ feet

______ INCH DIAMETER BOREHOLE ______ to ______ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ______ to ______ feet

TOP OF CASING AT 2.2' ~~2.4~~ FEET ABOVE ~~BELOW~~ AT GROUND LEVEL

10¼ INCH DIAMETER BOREHOLE 0 to 16.7 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING +2.4 to 4.2 feet

☑ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 0 to 1.0 feet

BENTONITE PELLET SEAL 1.0 to 3.0 feet

20/40 Morie Silica (NAME) (NUMBER) SAND PACK 3.0 to 16.7 feet

2 INCH DIAMETER SLOTTED (0.01) inch SCREEN 4.2 to 14.2 feet

2 INCH DIAMETER ~~SCHEDULE 40 PVC~~ S.Steel BLANK SILT TRAP 14.2 to 16.2 feet

BOTTOM WELL CAP 16.2 feet

HOLE CLEANED OUT TO 16.7 feet

BOTTOM OF BOREHOLE 16.7 feet

NOT TO SCALE

ADDITIONAL INFORMATION: ______

Halliburton NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Laker AFB

JOB NUMBER: D114 | PROJECT MANAGER: A Jenkins

LOGGED BY: BDH | EDITED BY: Jc Ellis

WELL NAME: MW1122 | DATE: 4/7/95

DRILLING COMPANY: Tri-State Testing

EQUIPMENT: ☒ 7¼ 10¼ OD. INCH HOLLOW STEM AUGER | DRILLER: Joe Fleggar
☐ ____ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: NA GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam Cleaner

DEVELOPMENT See Well Development Form

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

11.5 SACKS OF ~~#5~~ 50lb bag 20/40 Marie SAND

____ SACKS OF ____ CEMENT

____ GALLONS OF GROUT USED

____ SACKS OF POWDERED BENTONITE

75 POUNDS OF BENTONITE PELLETS

8.3 FEET OF 2 INCH PVC BLANK CASING

10.0 FEET OF 2 INCH ~~PVC~~ S.S. SLOTTED SCREEN

2.2 Feet of 2 inch S.S. silt trap

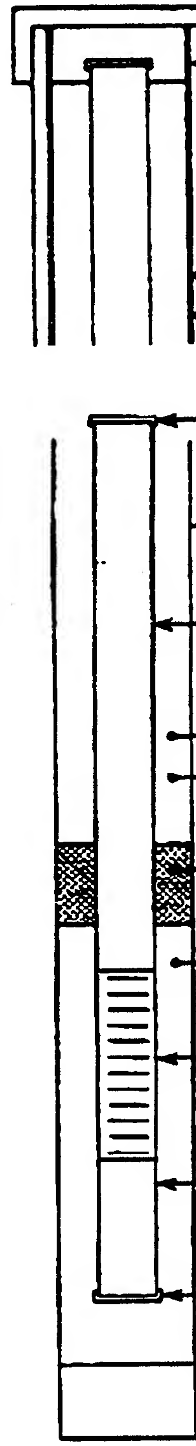
____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☐ YES

NAME ____

WELL COVER USED: ☐ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

____ INCH DIAMETER STEEL CONDUCTOR CASING ____ to ____ feet

____ INCH DIAMETER BOREHOLE ____ to ____ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

TOP OF CASING AT 2.3 ~~2.5~~ FEET ABOVE AT ~~BELOW~~ GROUND LEVEL

10¼ INCH DIAMETER BOREHOLE 0 to 17.9 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING +2.5 to 5.1 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 0 to 2.0 feet

BENTONITE PELLET SEAL 2.0 to 4.0 feet

20/40 Morie Silica (name) (number) SAND PACK 4.0 to 17.9 feet

2 INCH DIAMETER SLOTTED (0.01) inch SCREEN 5.1 to 15.1 feet

2 INCH DIAMETER ~~SCHEDULE 40 PVC~~ Steel BLANK SILT TRAP 15.1 to 17.3 feet

BOTTOM WELL CAP 17.3 feet

HOLE CLEANED OUT TO 17.9 feet

BOTTOM OF BOREHOLE 17.9 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Eaker AFB

JOB NUMBER: 0114 | PROJECT MANAGER: Allan Jenkins

LOGGED BY: G. Millar | EDITED BY: JR Ellis

WELL NAME: MW1123 | DATE: 8/11/95

DRILLING COMPANY: Tri state Testing services

EQUIPMENT: ☒ 10 INCH HOLLOW STEM AUGER | DRILLER: J. Crawford

☐ ______ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: 7 GALLONS for hydration

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam Cleaning

DEVELOPMENT See Well Development Form

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

OF R:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

DEPTH TO WATER AFTER DEVELOPMENT: FEET

JRE

MATERIALS USED

12.0 ~~115~~ RM 06 24 95 ~~GA~~ GA COOL WELL SACKS OF Morie 20/40 Filtration media SAND

______ SACKS OF ______ CEMENT

~10 GALLONS OF GROUT USED

______ SACKS OF POWDERED BENTONITE

75 ~~125~~ RM POUNDS OF BENTONITE PELLETS 1 1/2 buckets

10 FEET OF 2 INCH PVC BLANK CASING

10 FEET OF 2 INCH ~~PVC~~ SS SLOTTED SCREEN

2 FT of 2 inch SS silt trap.

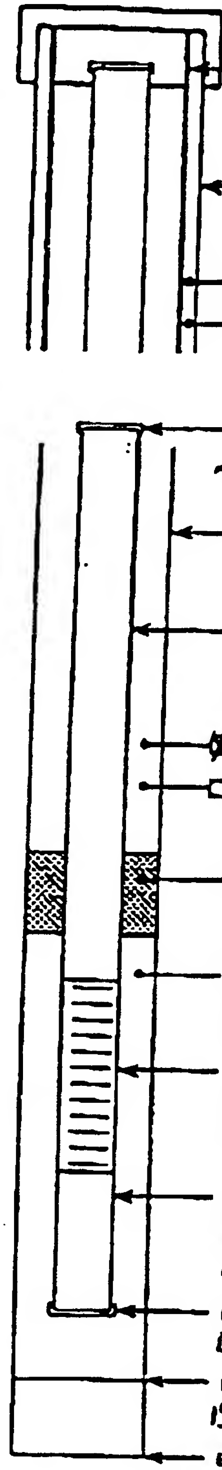
______ YARD^3 CEMENT-SAND (REDI-MIX) ORDERED

______ YARD^3 CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME grout mixed in 55 gal drum

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER



☐ CHRISTY BOX

☒ LOCKING STEEL COVER

______ INCH DIAMETER STEEL CONDUCTOR CASING ______ to ______ feet

______ INCH DIAMETER BOREHOLE ______ to ______ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ______ to ______ feet

TOP OF CASING AT ~2.5 FEET ABOVE AT BELOW GROUND LEVEL

10" INCH DIAMETER BOREHOLE 0 to 19.5 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0 to 19.0 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 0 to 3.0 feet

BENTONITE PELLET SEAL 3.0 to 5.0 feet

Morie 20/40 (NAME) (NUMBER) SAND PACK 5.0 to 19.5 feet

2 INCH DIAMETER SLOTTED (.010) inch SCREEN 7.0 to 17.0 feet

2 INCH DIAMETER SCHEDULE 40 ~~PVC~~ S-STEEL BLANK SILT TRAP 17.0 to 19.0 feet

BOTTOM WELL CAP 19.0 feet .5 ft of sand to 19.5.

HOLE CLEANED OUT TO 19.5 feet

BOTTOM OF BOREHOLE 19.5 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

Calculated Sand = 11.31 sacks

Calculated grout = 11.76 gal

Halliburton NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Eaker AFB

JOB NUMBER: 0114 | PROJECT MANAGER: Allan Jenkins

LOGGED BY: G. Millar | EDITED BY:

WELL NAME: MW1124 | DATE: 8/12/95

DRILLING COMPANY: Tri State Testing Services

EQUIPMENT: ☒ 10 INCH HOLLOW STEM AUGER | DRILLER: J. Crawford

☐ ____ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: 50 GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam Cleaning

DEVELOPMENT See Well Development form

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

~~OF~~ 2495 GROONWELL

12 1/2 SACKS OF Morie 20/40 Filtration media SAND

____ SACKS OF ____ CEMENT

~65 GALLONS OF GROUT USED

____ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS 1 1/2 buckets

30 FEET OF 2 INCH PVC BLANK CASING 2 Feet of Cut off.

10 FEET OF 2 INCH ~~PVC~~ SS SLOTTED SCREEN

2 FT of 2 inch ss silt trap

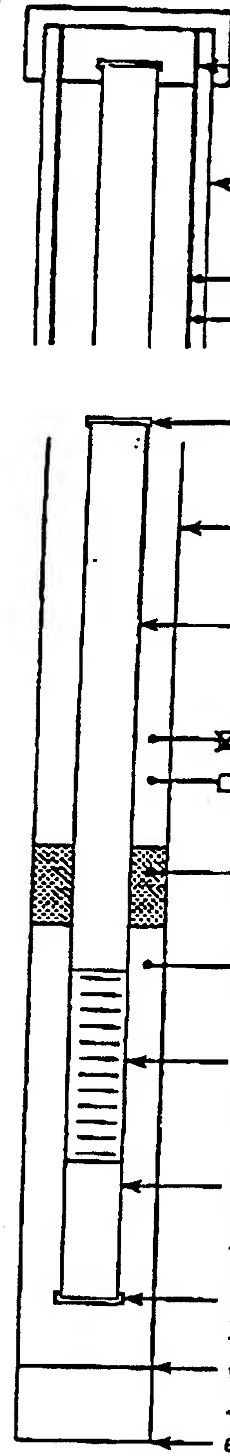
____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☒ NO ☐ YES

NAME grout mixed in 55 gal drum.

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

____ INCH DIAMETER STEEL CONDUCTOR CASING ____ to ____ feet

____ INCH DIAMETER BOREHOLE ____ to ____ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

TOP OF CASING AT 1.65 FEET ABOVE AT BELOW GROUND LEVEL

10 INCH DIAMETER BOREHOLE 0 to 38 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0 to 26 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 0 to 22 feet

BENTONITE PELLET SEAL 22 to 24 feet

Morie (NAME) 20/40 (NUMBER) SAND PACK 24 to 38 feet

2 INCH DIAMETER SLOTTED (0.010) inch: SCREEN 26 to 36 feet

2 INCH DIAMETER SCHEDULE 40 ~~PVC~~ SS BLANK SILT TRAP 36 to 38 feet

BOTTOM WELL CAP 38 feet

HOLE CLEANED OUT TO 38 feet

BOTTOM OF BOREHOLE 38 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

calculated Sand 10.92 sacks

calculated grout 86.24 gal.

Halliburton NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Eaker AFB

JOB NUMBER: 0114

PROJECT MANAGER: Allan Jenkins

LOGGED BY: G. Millar

EDITED BY: [signature] Ellis

WELL NAME: MW1125

DATE: 10/31/95

DRILLING COMPANY: Tri State Testing Services

EQUIPMENT: ☒ 7 1/4 INCH HOLLOW STEM AUGER ☐ ______ INCH ROTARY WASH

DRILLER: J. Crawford

HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: 70 GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam Cleaning

DEVELOPMENT See Well Development Form

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO		DATE:
YIELD: GPM	TIME: FROM TO		DATE:
YIELD: GPM	TIME: FROM TO		DATE:
YIELD: GPM	TIME: FROM TO		DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ______

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

9 SACKS OF 090895 GA CONWELL Morie 20/40 filtration media SAND

______ SACKS OF ______ CEMENT

______ GALLONS OF GROUT USED

______ SACKS OF POWDERED BENTONITE

______ POUNDS OF BENTONITE PELLETS 1 1/4 buckets

30 FEET OF 2 INCH PVC BLANK CASING 1.5ft. cut off.

10 FEET OF 2 INCH ~~PVC~~ SS SLOTTED SCREEN

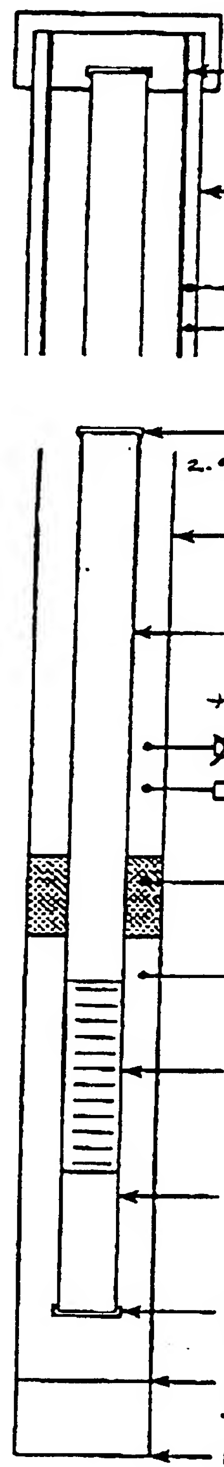
2 FT of 2 inch SS. silt trap

______ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

______ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☒ YES

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ______



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

______ INCH DIAMETER STEEL CONDUCTOR CASING ______ to ______ feet

______ INCH DIAMETER BOREHOLE ______ to ______ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ______ to ______ feet

TOP OF CASING AT 2.9 ~~2.5~~ FEET (ABOVE) AT BELOW GROUND LEVEL

10 INCH DIAMETER BOREHOLE 0 to 38 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING +2.5 to 26 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 0 to 22 feet

BENTONITE PELLET SEAL 22 to 24 feet

Morie 20/40 (00N) (NAME) (NUMBER) SAND PACK 24 to 38 feet

2 INCH DIAMETER SLOTTED (0.010) inch SCREEN S.S. 26 to 36 feet

2 INCH DIAMETER SCHEDULE 40 ~~PVC~~ S.S. BLANK SILT TRAP 36 to 38 feet

BOTTOM WELL CAP 38 feet

HOLE CLEANED OUT TO 38 feet

BOTTOM OF BOREHOLE 38 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

Calculated Sand = 10.925 sacks

Calculated grout = 80.36 gals

Halliburton NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Eaker AFB

JOB NUMBER: 0114 | PROJECT MANAGER: Allan Jenkins

LOGGED BY: G. Millar | EDITED BY:

WELL NAME: MW1126 | DATE: 11/01/95

DRILLING COMPANY: Tri-state Testing Services

EQUIPMENT: ☑ 7 1/4 INCH HOLLOW STEM AUGER | DRILLER: J. Crawford

☐ ____ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: 52 GALLONS to equalize pressure

METHOD OF DECONTAMINATION PRIOR TO DRILLING: steam cleaning

DEVELOPMENT See Well Development Form

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD:	TIME:		DATE:
GPM	FROM	TO	
GPM	FROM	TO	
GPM	FROM	TO	
GPM	FROM	TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

9 1/2 SACKS OF Morie 20/40 filtration media SAND 090895 6A CONWELL

____ SACKS OF ____ CEMENT

____ GALLONS OF GROUT USED

____ SACKS OF POWDERED BENTONITE

50 POUNDS OF BENTONITE PELLETS 1 bucket

35 FEET OF 2 INCH PVC BLANK CASING 3.5 ft cut off

10 FEET OF 2 INCH ~~PVC~~ S.S. SLOTTED SCREEN

2 FT of 2 inch S.S. Silt trap

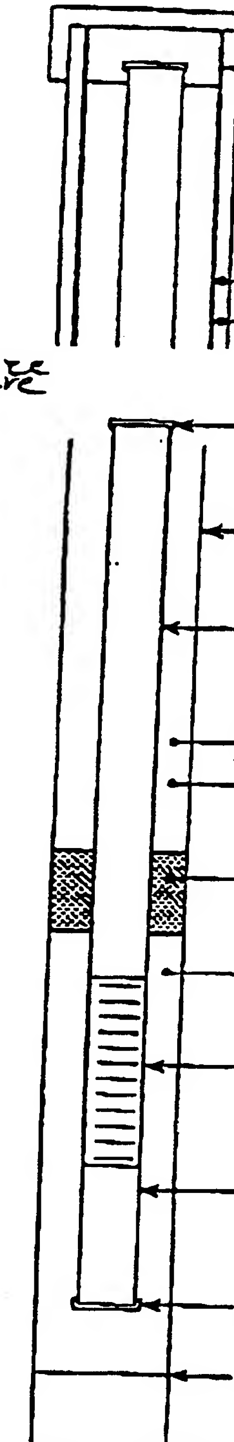
____ YARD^3 CEMENT-SAND (REDI-MIX) ORDERED

____ YARD^3 CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☒ YES

NAME

WELL COVER USED: ☒ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER ____



☐ CHRISTY BOX

☐ LOCKING STEEL COV[ER]

____ INCH DIAMET[ER] STEEL CONDUCTOR CASING ____ to ____ feet

____ INCH DIAMETER BOREHOLE ____ to ____ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

TOP OF CASING AT 2.5 FEET (ABOVE) AT BELOW GROUND LEVEL

10 INCH DIAMETER BOREHOLE 0 to 41 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING +2.5 to 29 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 0 to 22 feet

BENTONITE PELLET SEAL 22 to 24 feet

Morie 20/40 (coarse) (NAME) (NUMBER) SAND PACK 27 to 41 feet

2 INCH DIAMETER SLOTTED (0.010) inch SCREEN 29 to 39 feet

2 INCH DIAMETER SCHEDULE 40 ~~PVC~~ STAINLESS STEEL BLANK SILT TRAP 39 to 41 feet

BOTTOM WELL CAP 41 feet

HOLE CLEANED OUT TO 41 feet

BOTTOM OF BOREHOLE 41 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

Calculated sand = 10.92 bags

Calculated grout = 98 gals

Halliburton NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Eaker AFB

JOB NUMBER: 0114

PROJECT MANAGER: Allan Jenkins

LOGGED BY: G. Millar

EDITED BY:

WELL NAME: MW1127

DATE: 11/03/95

DRILLING COMPANY: Tri State Testing Services

EQUIPMENT: ☒ 10¼ INCH HOLLOW STEM AUGER ☐ ____ INCH ROTARY WASH

DRILLER: J. Crawford

HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: 41 GALLONS for equalization of pressure

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam Cleaning

DEVELOPMENT

See Well Development Form

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD	TIME	DATE
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	
GPM	FROM TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

10 SACKS OF Morie 20/40 Filtration media SAND 090895GAOONWELL

____ SACKS OF ____ CEMENT

____ GALLONS OF GROUT USED

____ SACKS OF POWDERED BENTONITE

75 POUNDS OF BENTONITE PELLETS 1½ buckets

30 FEET OF 2 INCH PVC BLANK CASING 2.5 cut off.

10 FEET OF 2 INCH S.S. SLOTTED SCREEN

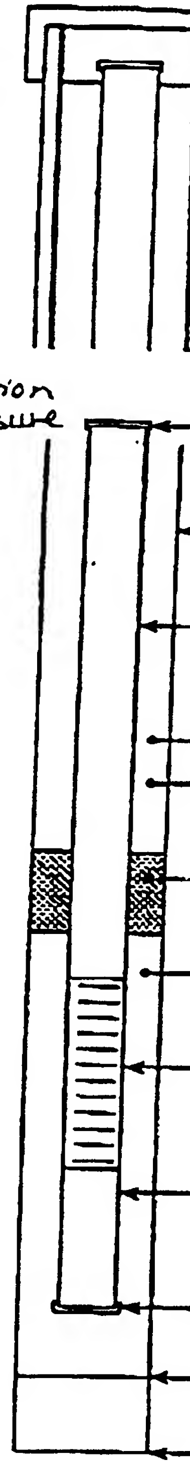
2 FT of 2 inch S.S. silt trap

____ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

____ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☒ YES

WELL COVER USED: ☐ LOCKING STEEL COVER ☐ CHRISTY BOX ☒ OTHER Flushmount



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

____ INCH DIAMETER STEEL CONDUCTOR CASING ____ to ____ feet

____ INCH DIAMETER BOREHOLE ____ to ____ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ____ to ____ feet

TOP OF CASING AT 0.3 FEET ABOVE AT BELOW GROUND LEVEL

10 INCH DIAMETER BOREHOLE 0 to 36.5 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING +3 to 24.5 feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 0 to 20.5 feet

BENTONITE PELLET SEAL 20.5 to 22.5 feet

Morie 20/40 (OON) (NAME) (NUMBER) SAND PACK 22.5 to 36.5 feet

2 INCH DIAMETER SLOTTED (0.010) inch SCREEN 24.5 to 34.5 feet

2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP 34.5 to 36.5 feet

BOTTOM WELL CAP 36.5 feet

HOLE CLEANED OUT TO 36.5 feet

BOTTOM OF BOREHOLE 36.5 feet

NOT TO SCALE

ADDITIONAL INFORMATION:

Calculated Sand = 10.92 Sacks

Calculated grout = 80.36 gals

SENT BY:BROWN AND ROOT,ENV ;12-28-95 ; 4:58PM ; → USW;# 9/10

Halliburton NUS CORPORATION

FIELD WELL COMPLETION FORM

JOB NAME: Eaker AFB

JOB NUMBER: 0114 | PROJECT MANAGER: Allan Jenkins

LOGGED BY: G. Millar | EDITED BY:

WELL NAME: MW1128 | DATE: 11/05/95

DRILLING COMPANY: Tri State Testing Services

EQUIPMENT: ☒ 7¼ INCH HOLLOW STEM AUGER | DRILLER: J. Crawford

☐ ______ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: 70 GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING: Steam Cleaning

DEVELOPMENT See Well Development Form

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD:	TIME:		DATE:
GPM	FROM	TO	
GPM	FROM	TO	
GPM	FROM	TO	
GPM	FROM	TO	

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER ______

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

2½ SACKS OF 080995GAOONWELL Morie 20/40 filtration media SAND

______ SACKS OF ______ CEMENT

______ GALLONS OF GROUT USED

______ SACKS OF POWDERED BENTONITE

25 POUNDS OF BENTONITE PELLETS ½ bucket

30 FEET OF 2 INCH PVC BLANK CASING w/2ft. cut off.

10 FEET OF 2 INCH ~~PVC~~ S.S. SLOTTED SCREEN

2 FT of 2 inch S.S. silt trap

______ YARD³ CEMENT-SAND (REDI-MIX) ORDERED

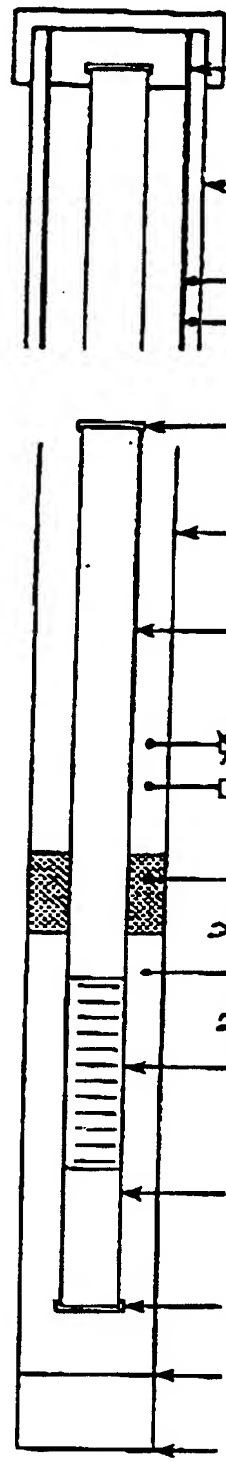
______ YARD³ CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☒ YES

NAME ______

WELL COVER USED: ☐ LOCKING STEEL COVER ☐ CHRISTY BOX ☒ OTHER Flush mount

* 12" borehole to 25'
7¼" borehole to 40.0'



☐ CHRISTY BOX

☐ LOCKING STEEL COVER

______ INCH DIAMETER STEEL CONDUCTOR CASING ______ to ______ feet

______ INCH DIAMETER BOREHOLE ______ to ______ feet

☐ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL ______ to ______ feet

TOP OF CASING AT 0 FEET (ABOVE) AT BELOW GROUND LEVEL

12 ~~10~~ INCH DIAMETER BOREHOLE 7¼ inch bo... 0 to 25' feet ... 25.0 –

2 INCH DIAMETER SCHEDULE 40 PVC BLANK CASING 0 to 28 feet

☒ BENTONITE-CEMENT SEAL OR ☐ 8-SACK CEMENT-SAND SEAL 0 to 23.5 feet

BENTONITE PELLET SEAL 23.5 to 25.5 feet

(NAME) (NUMBER) SAND PACK 25.5 to ~~38~~ 40 feet

2 INCH DIAMETER SLOTTED (.010) inch SCREEN 28 to 38 feet

2 INCH DIAMETER SCHEDULE 40 ~~PVC~~ SS. BLANK SILT TRAP 38 to 40 feet

BOTTOM WELL CAP 40 feet

HOLE CLEANED OUT TO 40 feet

BOTTOM OF BOREHOLE 40 feet

NOT TO SCALE

ADDITIONAL INFORMATION ______

calculated sand = 6.86 sacks
calculated grout = 137 ga...
(calculations based on 12 inch borhole w/ 2 inch casing + 8.0' borehole w/ 2 inch casing -

SURVDATA.XLS

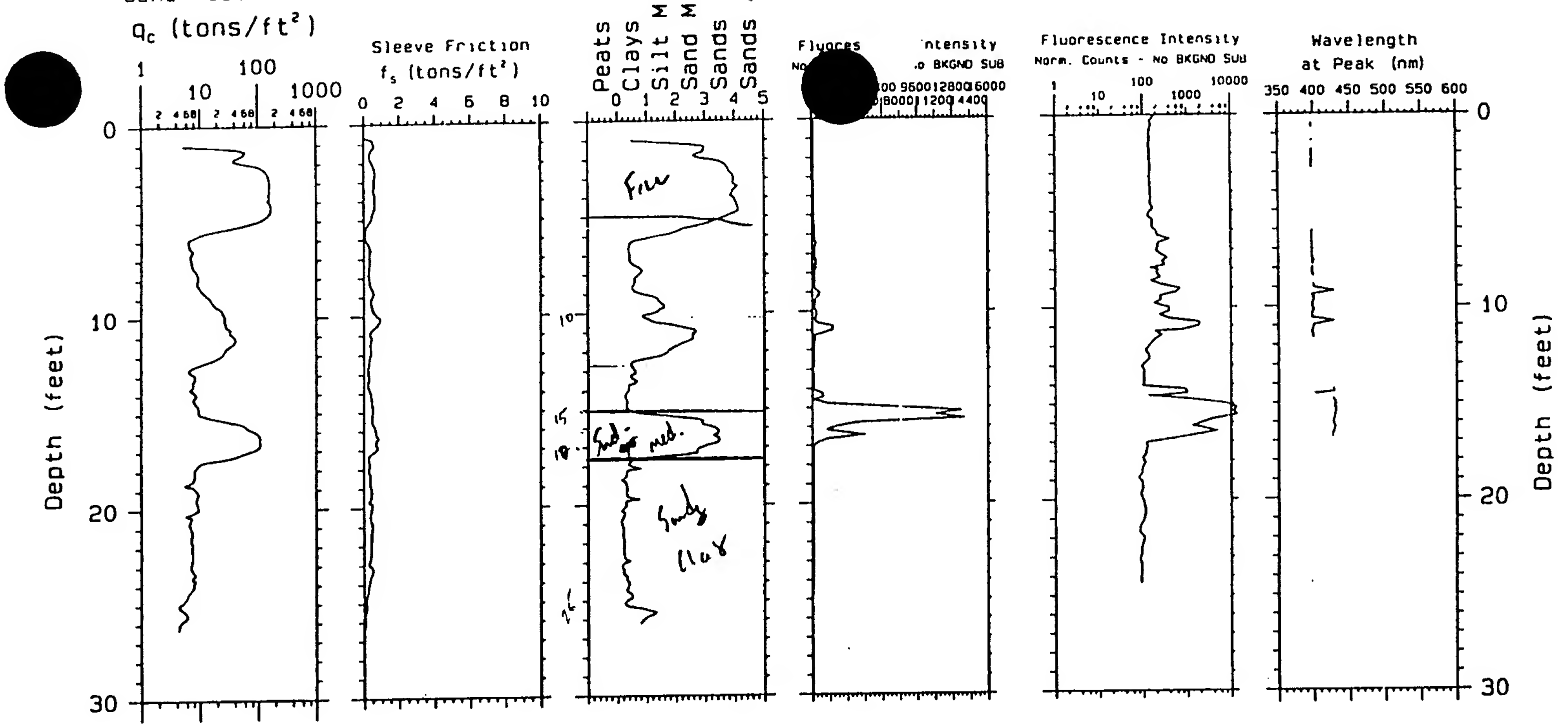
SAMPLE LOCATION/ELEVATION
EAKER AIR FORCE BASE, ARKANSAS

Sample Point	Elevation TOC	Ground Elevation	Coordinates Northing	Coordinates Easting	Site
TW1102	249.52		599301.20	2604930.49	BX
TW1103	249.99		599245.87	2605004.10	BX
MW1104	251.48		599380.79	2605116.02	BX
TW1105	251.14		599340.38	2604984.22	BX
TW1106	250.98		599356.10	2604925.65	BX
TW1107	251.31		599377.34	2605044.84	BX
TW1108	250.75		599297.47	2605018.95	BX
TW1109	250.89		599269.70	2605047.84	BX
MW1110	251.23		599285.35	2605052.46	BX
MW1111	251.32		599445.92	2605047.22	BX
TW1112	250.86		599348.57	2605017.22	BX
TW1113	252.01		599449.00	2604918.04	BX
MW1114	251.64		599513.89	2604985.04	BX
MW1115	250.37		599355.32	2604845.78	BX
MW1116	250.62		599187.31	2604940.79	BX
TW1117	250.83		599261.14	2605070.50	BX
TW1118	250.42		599233.00	2605100.52	BX
MW1119	249.75		599198.81	2605113.49	BX
MW1120	251.73		599447.41	2604838.18	BX
MW1121	253.16	250.97	599307.09	2605212.18	BX
MW1122	253.02	250.68	599488.98	2605029.14	BX
MW1123	253.56	251.13	599426.94	2604884.90	BX
MW1124	253.58	251.93	599440.75	2604894.57	BX
MW1125	253.48	250.88	599527.42	2604778.84	BX
MW1126	253.70	250.91	599313.88	2605207.14	BX
MW1127	250.56	250.76	599181.58	2604946.87	BX
MW1128	STILL REMAINING TO BE SURVEYED				BX
CP03		251.12	599361.54	2604978.20	BX
CP19					BX
CP22					BX
CP26		251.12	599356.27	2604925.70	BX
B1		252.18	599386.58	2605029.03	BX
B2		251.96	599388.57	2605019.62	BX
B3		251.85	599388.65	2605008.02	BX
B4		251.75	599381.05	2604999.58	BX
B5		251.64	599373.17	2604995.29	BX
B6		251.77	599350.54	2604998.47	BX
B7		250.97	599348.42	2605017.32	BX
B8		250.98	599340.55	2605031.63	BX
B9		251.12	599347.35	2605041.38	BX
B10		251.23	599354.04	2605048.24	BX
B11		251.26	599361.16	2605055.91	BX
B12		251.56	599376.42	2605049.23	BX
B13		252.50	599393.30	2605039.89	BX

CPT/LIF OUTPUT

BX SHOPPETTE

Source: USACE 1995, 1996



Project; Eaker AFB <NEW>
Probe Depth; 26.50

Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

CPT; 01EAK01

Probing date; 03-24-1995

Probe Depth; 26.45

fluorescence of POL via fiber optics

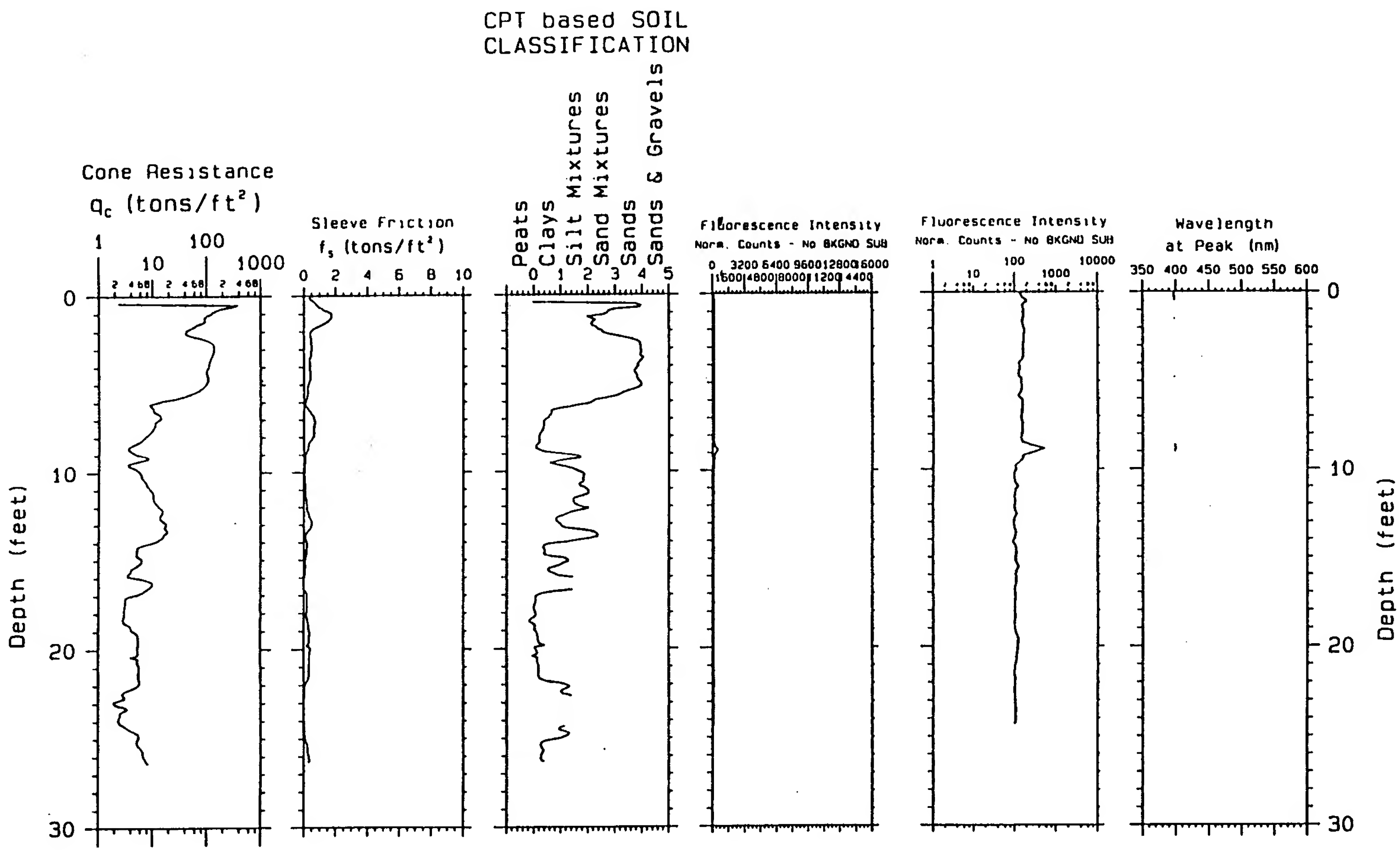
U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

CPT; 2EAK01

Probing date; 03-24-1995



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

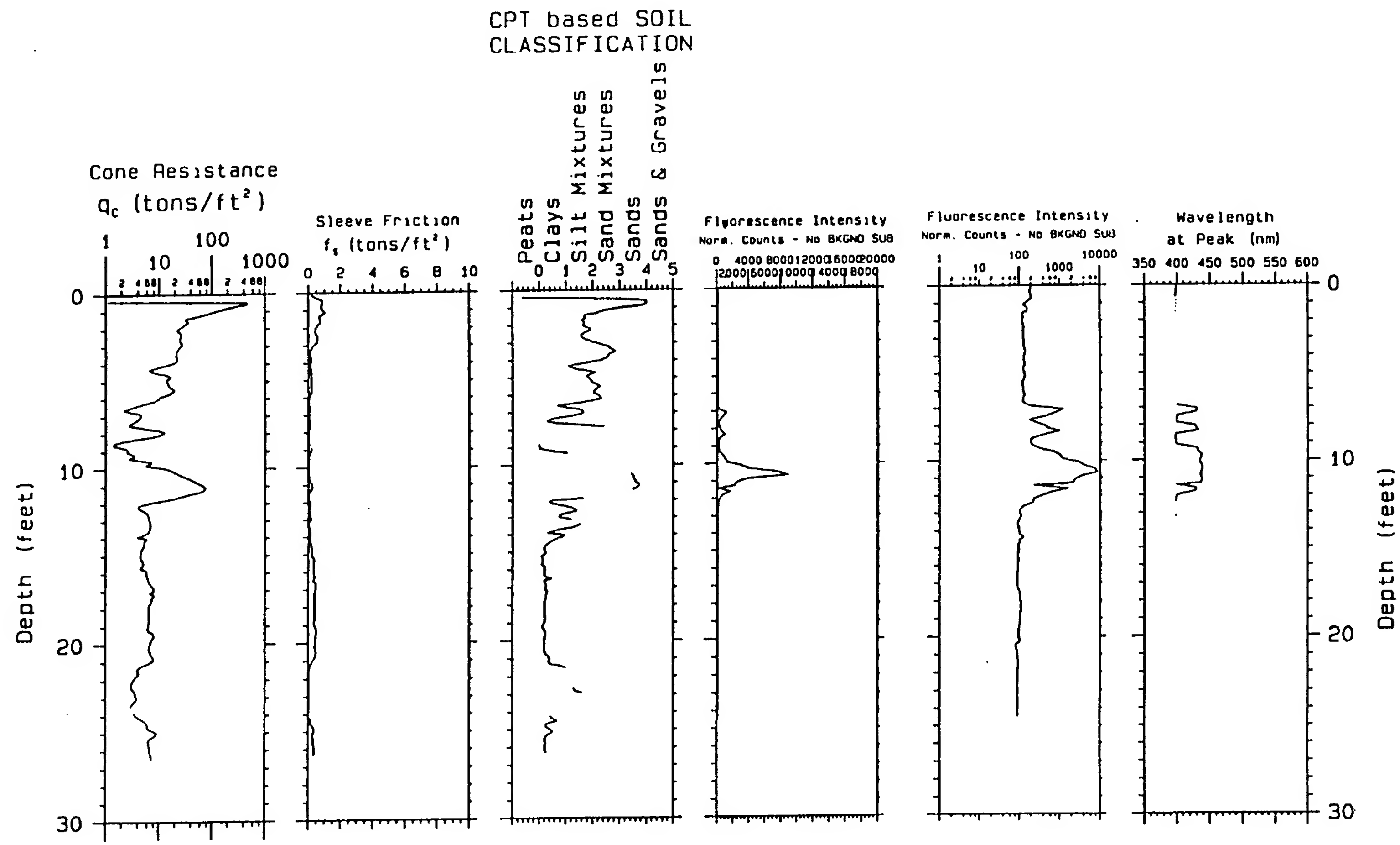
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 26.59

CPT; 4E K01

Prob ; 03-24-1995



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

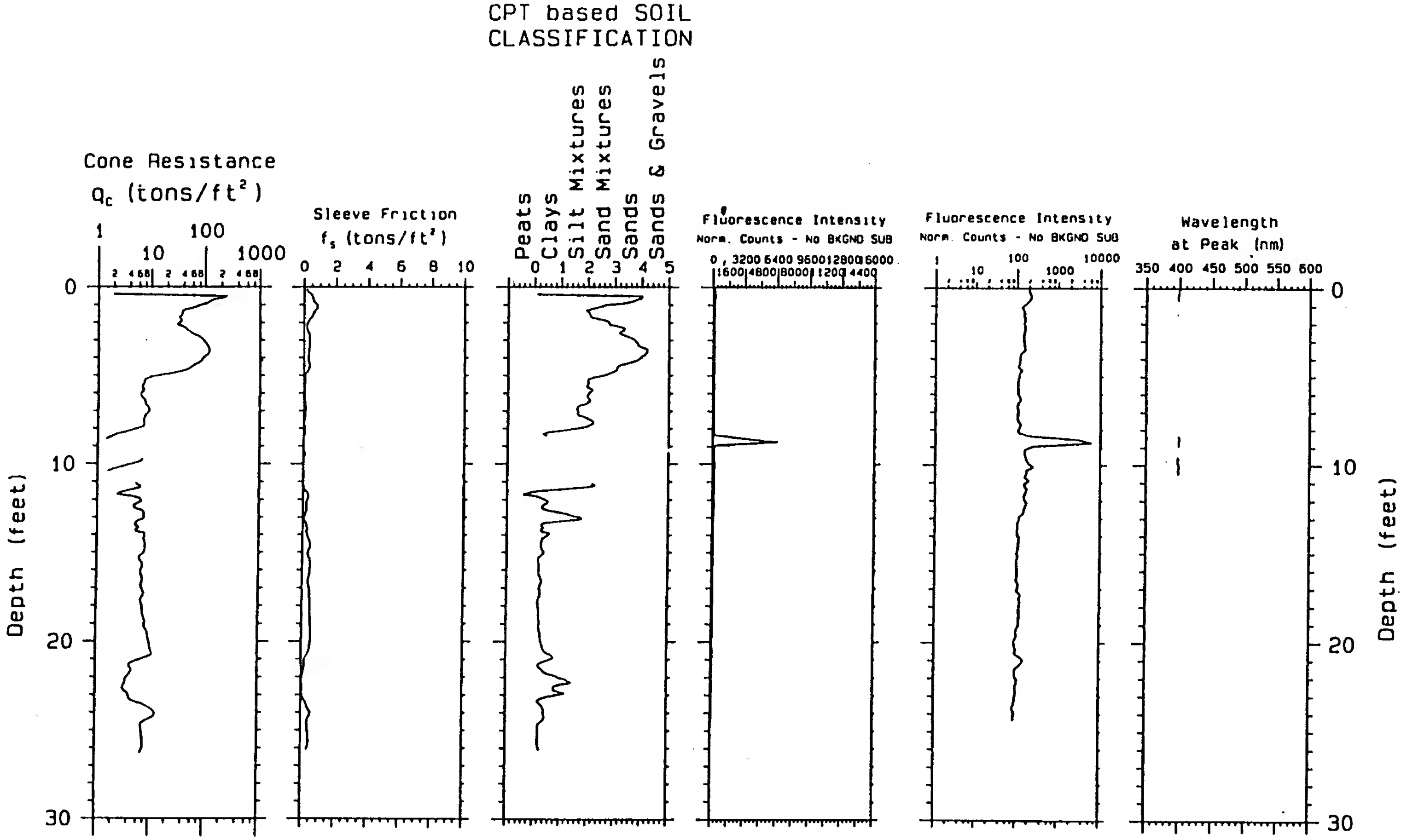
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 26.61

CPT; 5EAK01

Probing date; 03-24-1995



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS Site Characterization and Analysis Penetrometer System

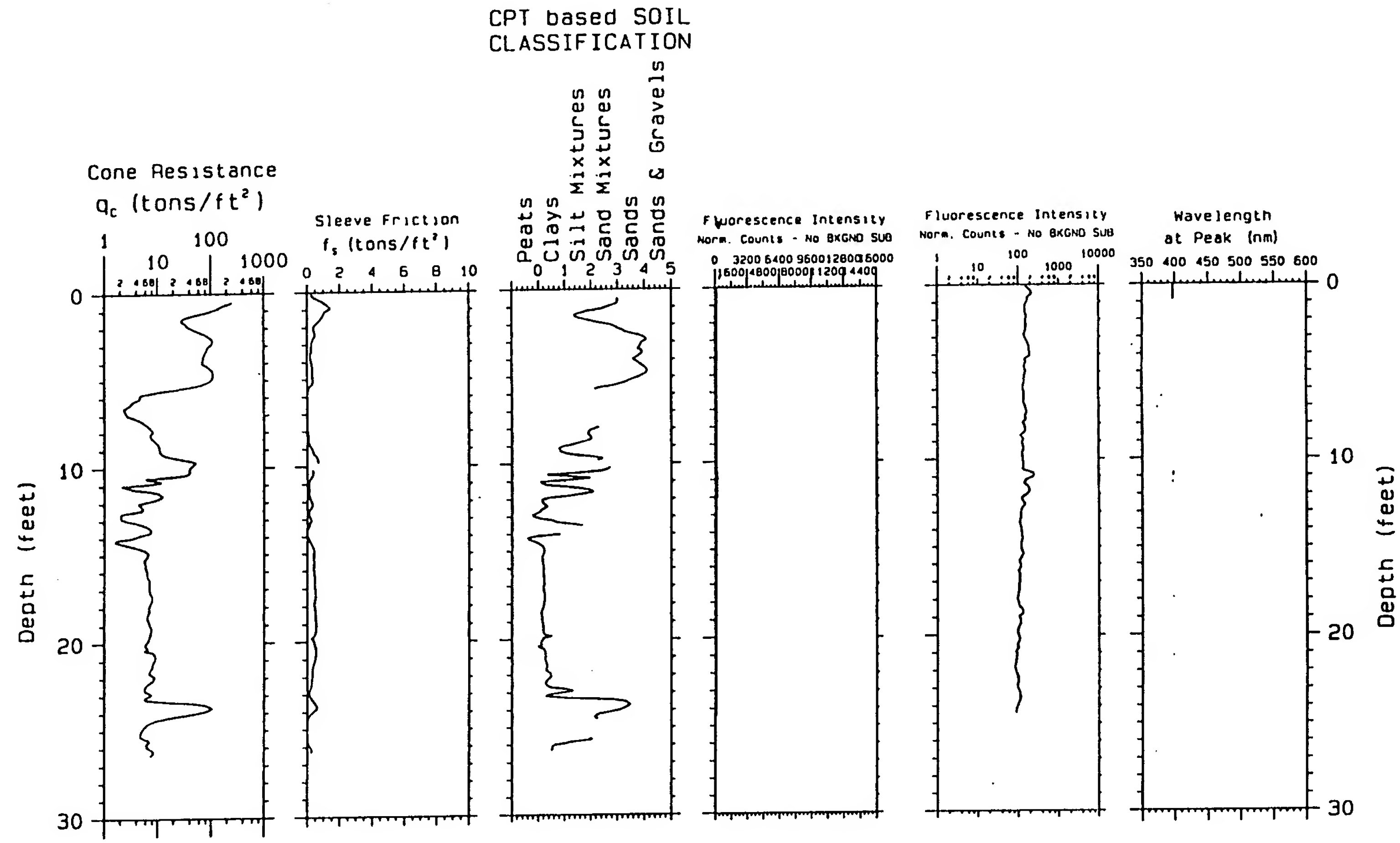
Project; Eaker AFB

Probe Depth; 26.50

Prob

03-24-1995

CPT; 6E 1



Project; Eaker AFB

Probe Depth; 26.55

Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

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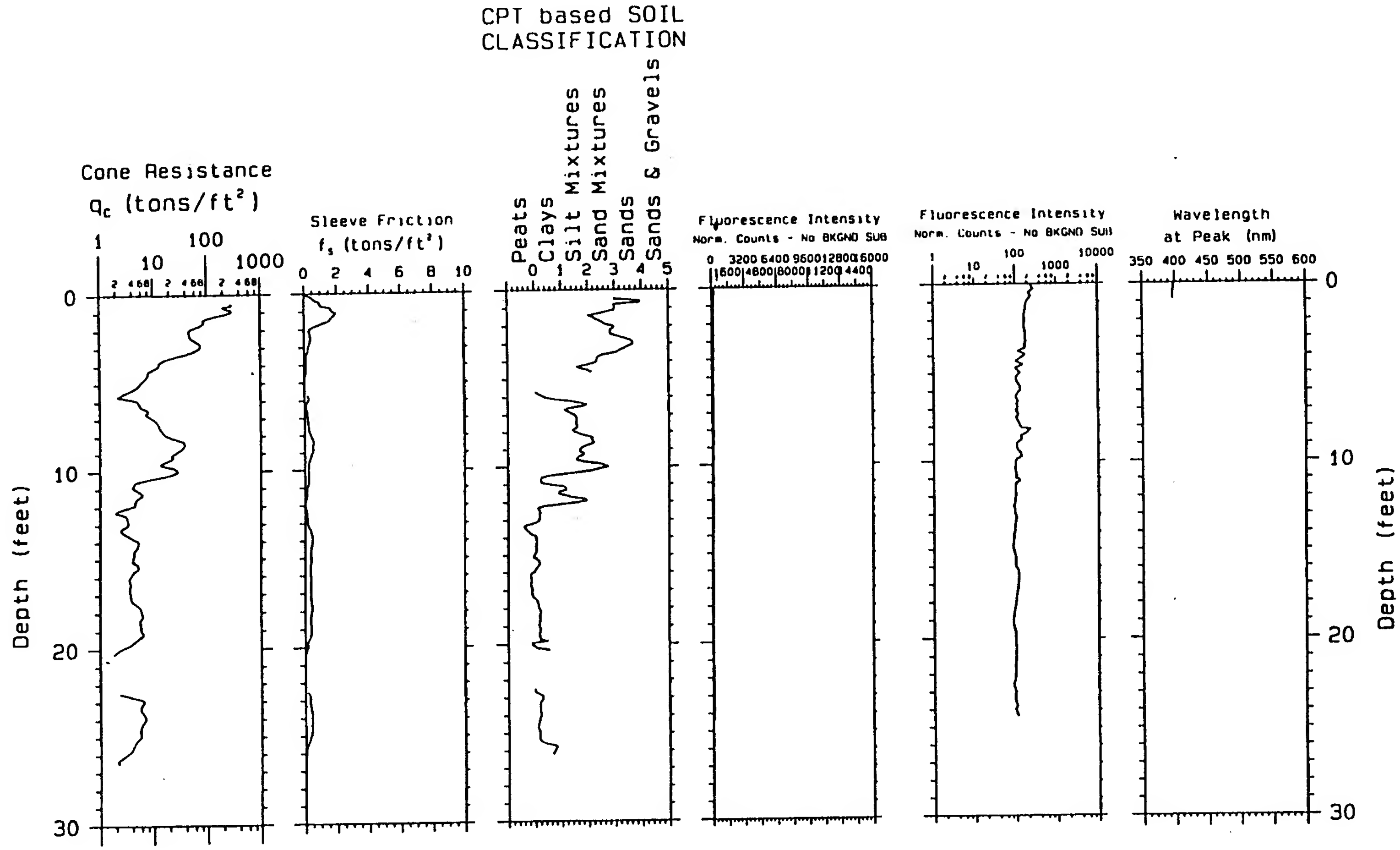
Site Characterization and Analysis Penetrometer System

CPT; 7EAK01

Probing date; 03-24-1995



Project; Eaker AFB

Probe Depth; 26.60

Laser induced fluorescence of POL via fiber optics

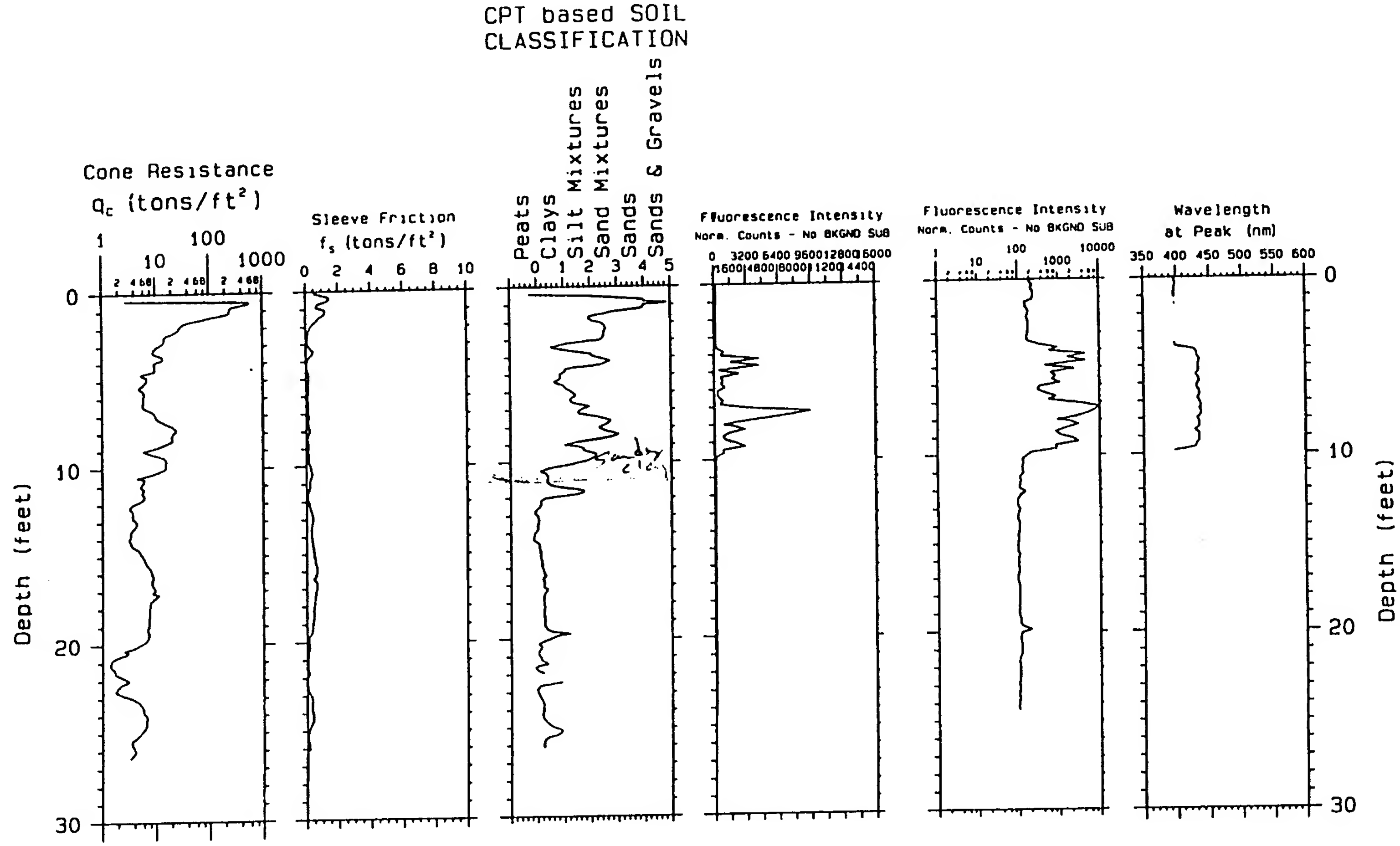
U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

CPT; 8EAK01

Pro e; 03-24-1995



Probing date: 03-24-1995

Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

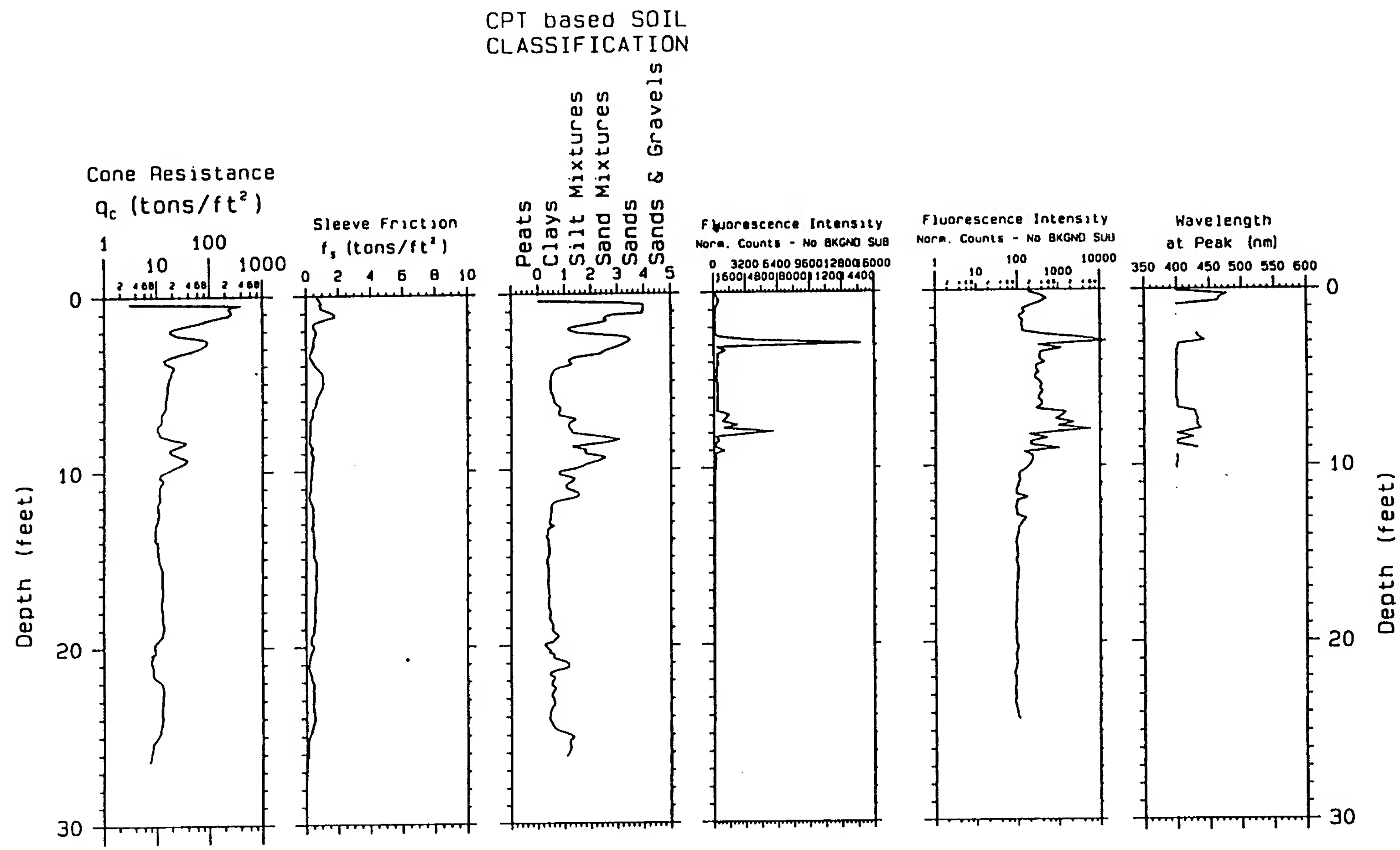
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 26.52

CPT; 9EAK01

MW 11-57



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

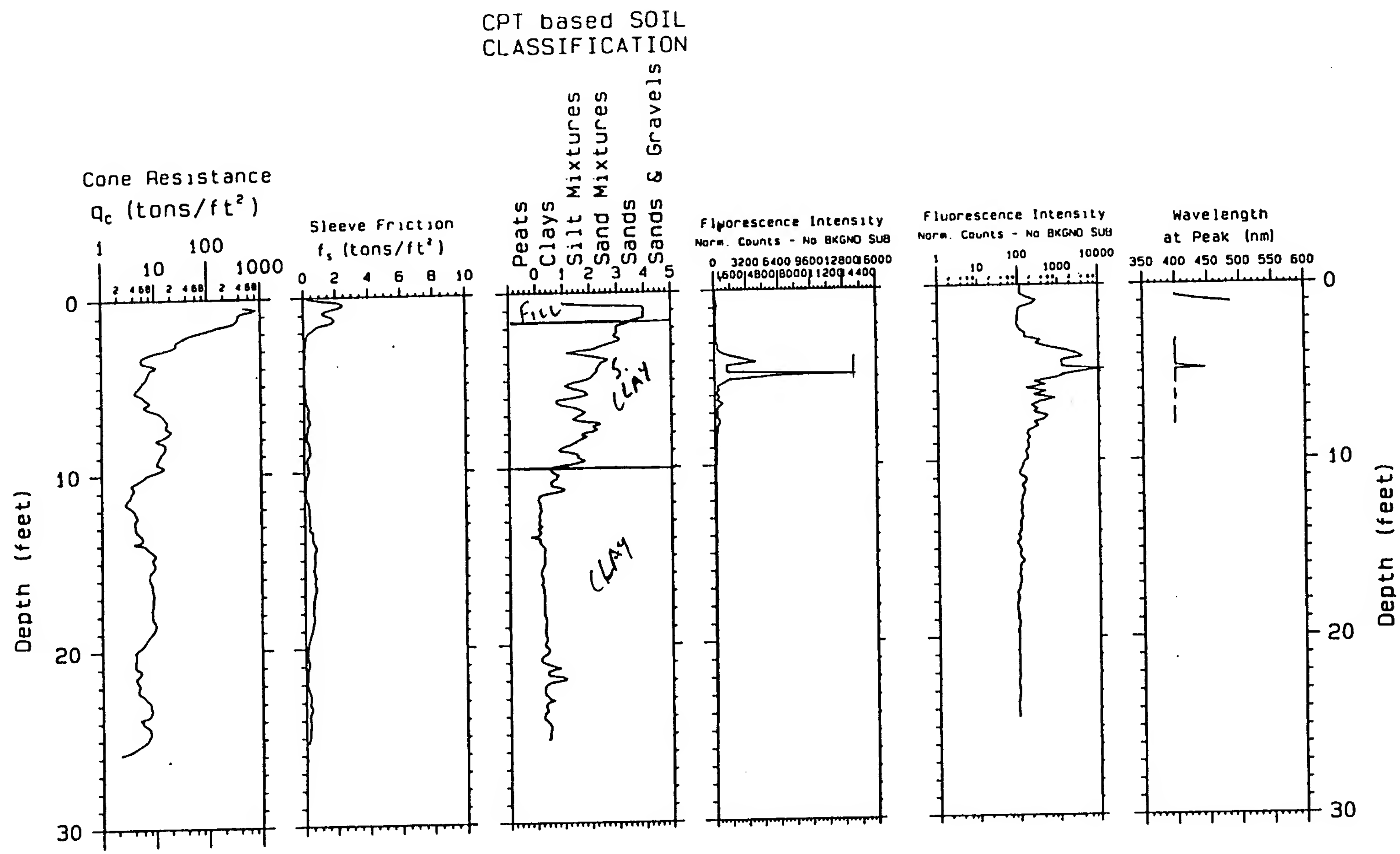
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 26.55

CPT; 10EAK01

Pro[illegible]e; 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

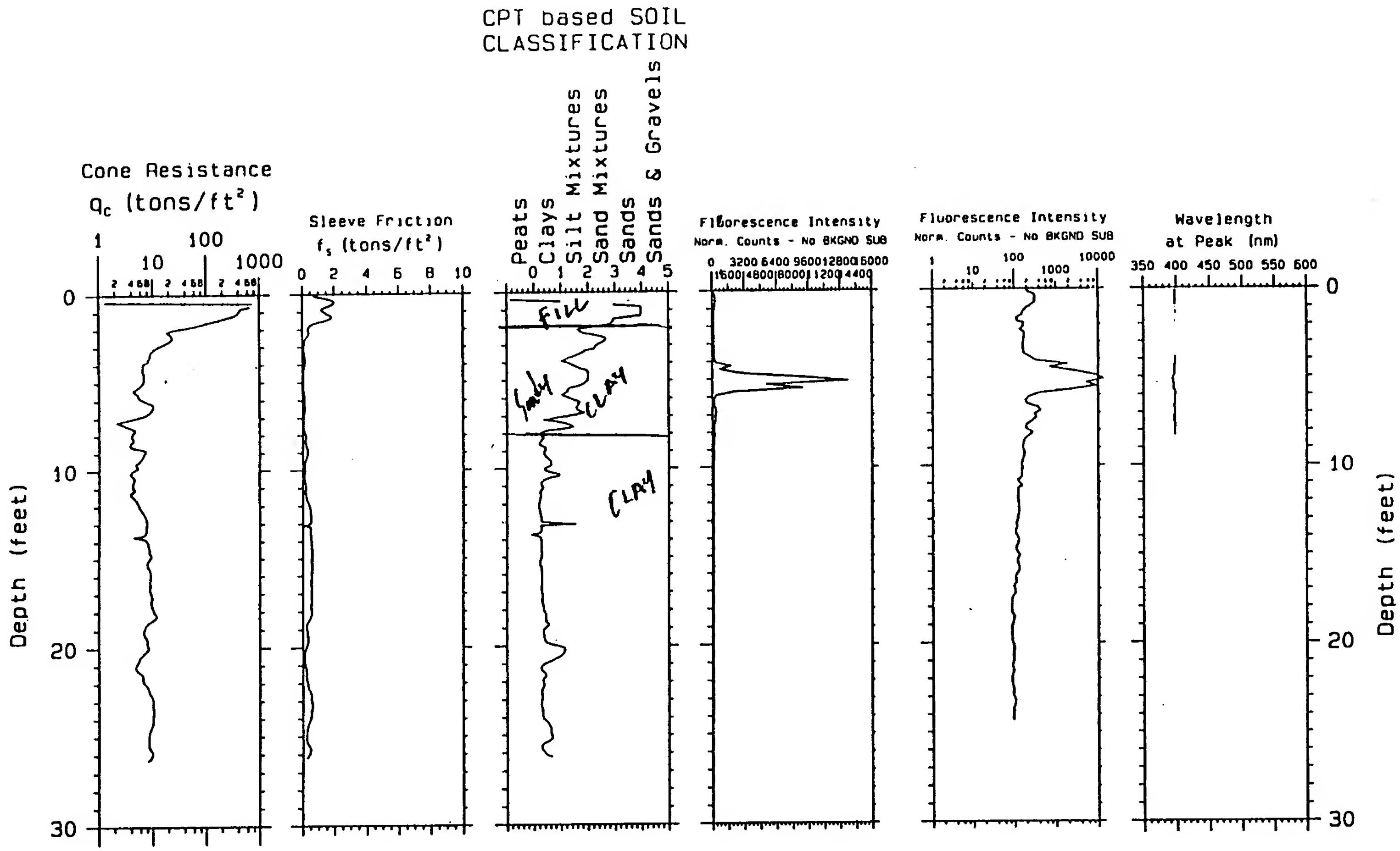
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 26.62

CPT; 11EAK01

Probing date: 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

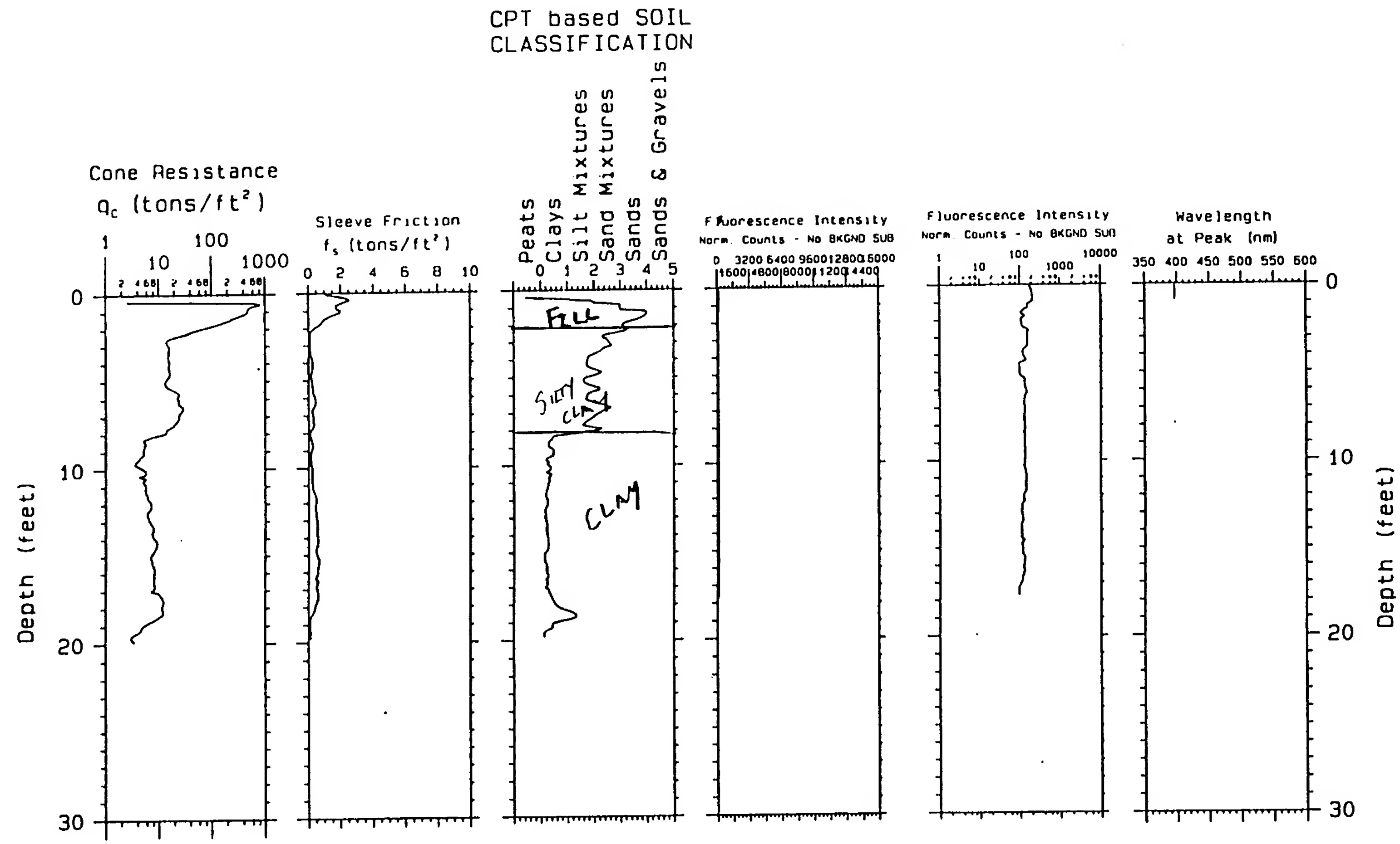
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 26.49

CPT; 12[redacted]K01

Prob[redacted]e; 03-25-1995



Probing date; 03-25-1995	Project; Eaker AFB
	Probe Depth; 20.05

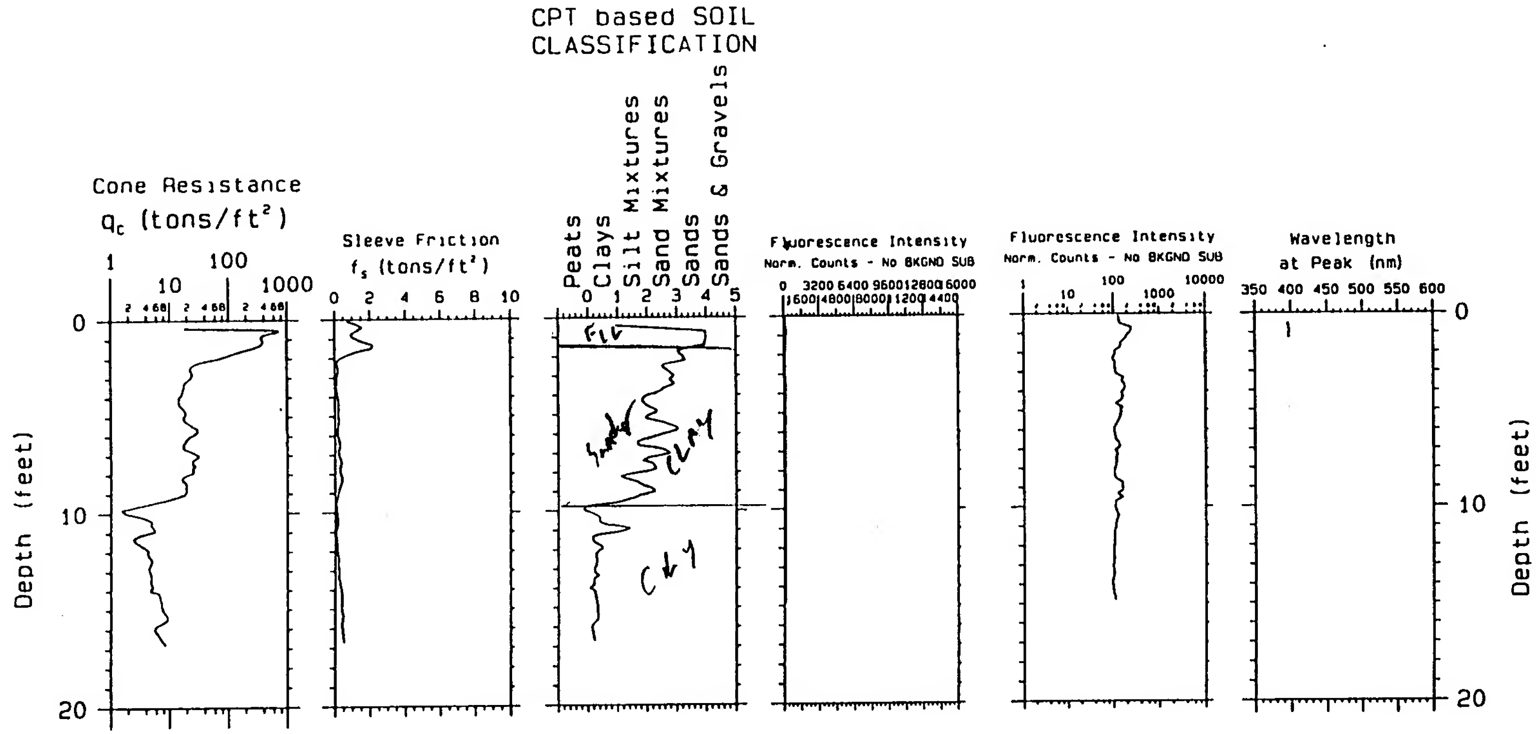
Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

CPT; 13EAK01



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

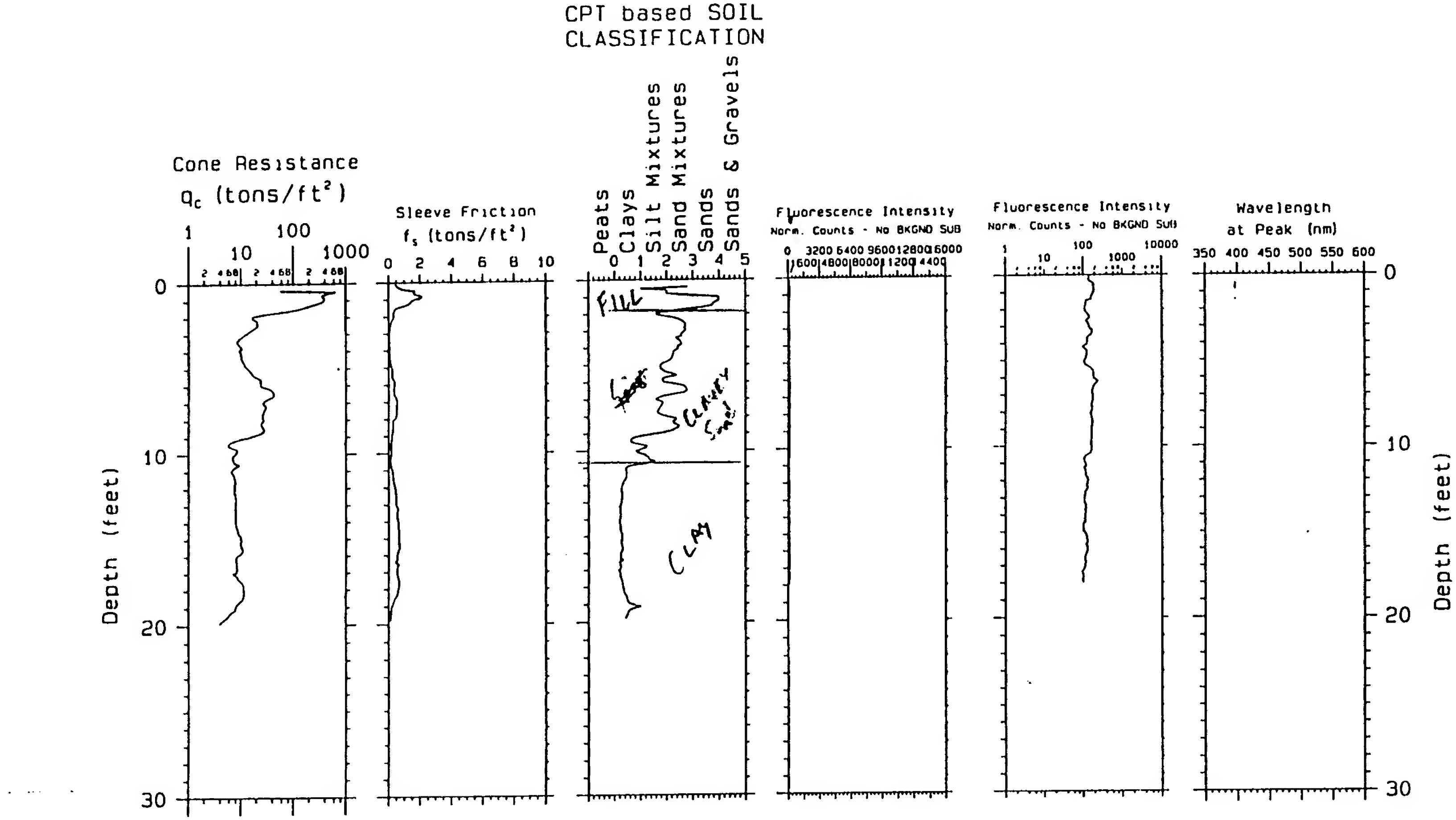
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 17.04

CPT; 14EAK01

Prob[illegible]e; 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

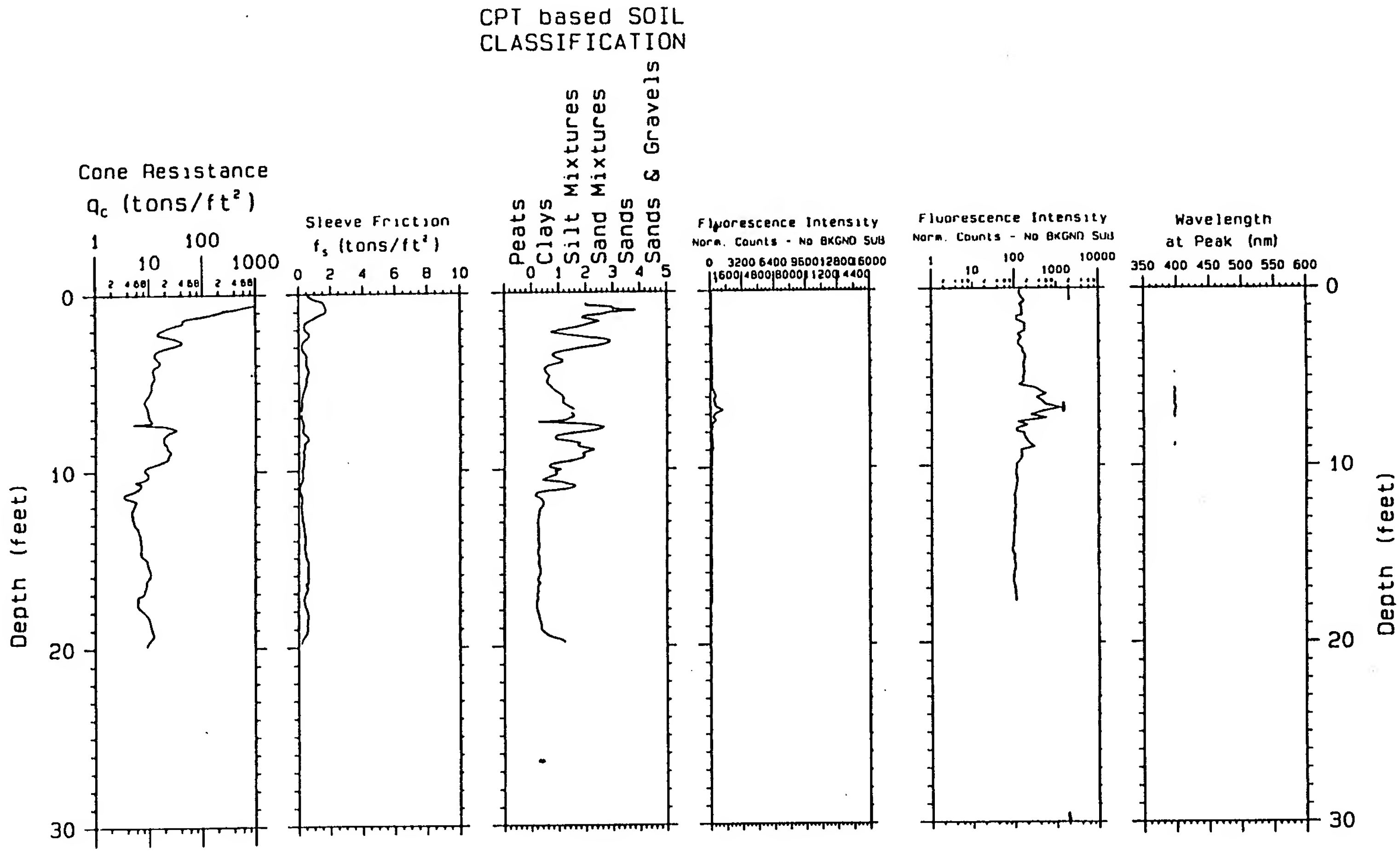
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 20.12

CPT; 15EAK01

Probing date; 03-25-1995



Prob[illegible]e: 03-25-1995

Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

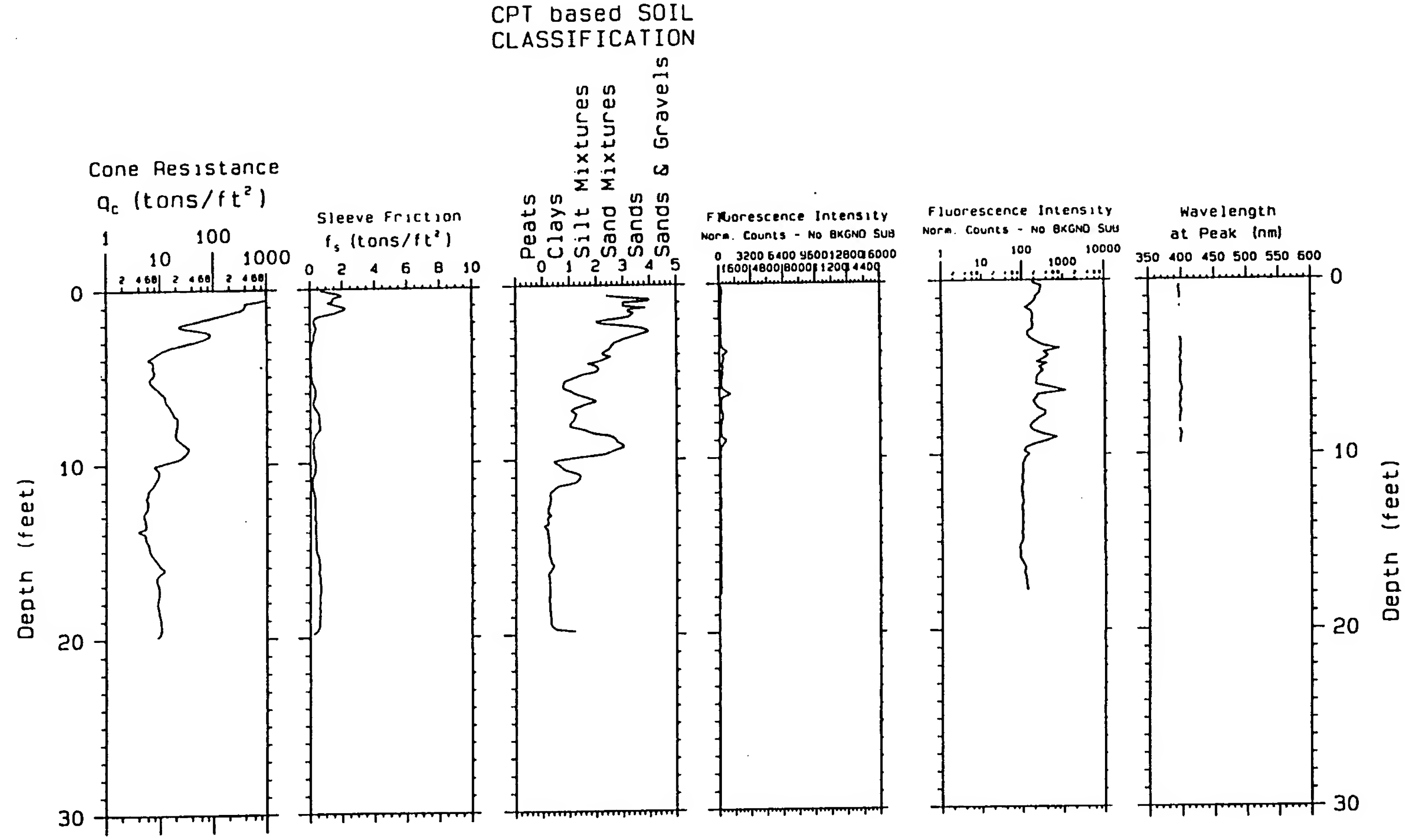
SCAPS

Site Characterization and Analysis Penetrometer System

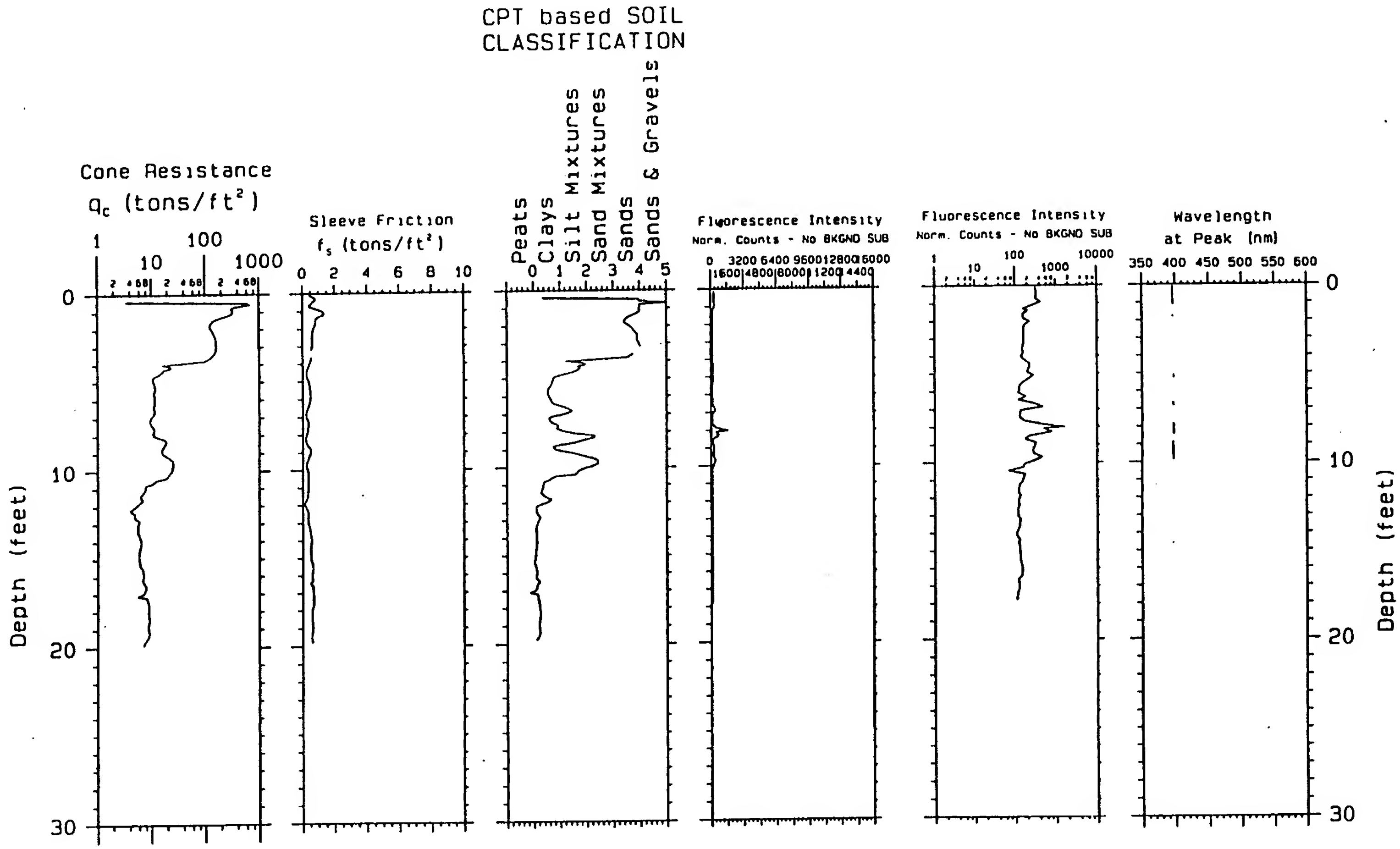
Project; Eaker AFB

Probe Depth; 20.05

CPT; 16[illegible]AK01



Probing date; 03-25-1995	Project; Eaker AFB
Laser induced fluorescence of POL via fiber optics	Probe Depth; 20.03
U.S. Army Engineer District Kansas City Geotechnical Branch	
SCAPS Site Characterization and Analysis Penetrometer System	CPT; 17EAK01



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

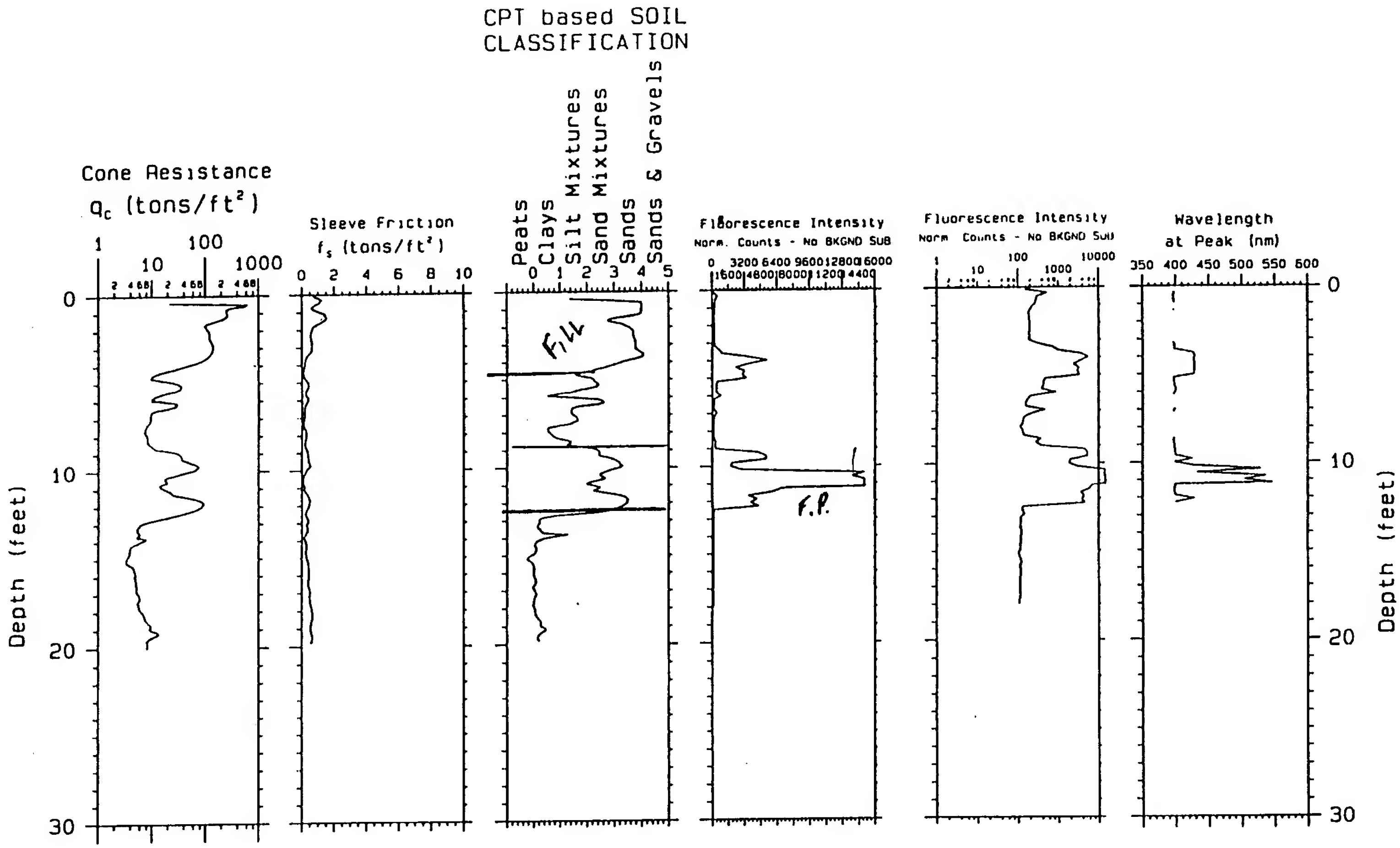
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 20.09

CPT; 18EAK01

Prob e: 03-25-1995



Probing date: 03-25-1995

Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

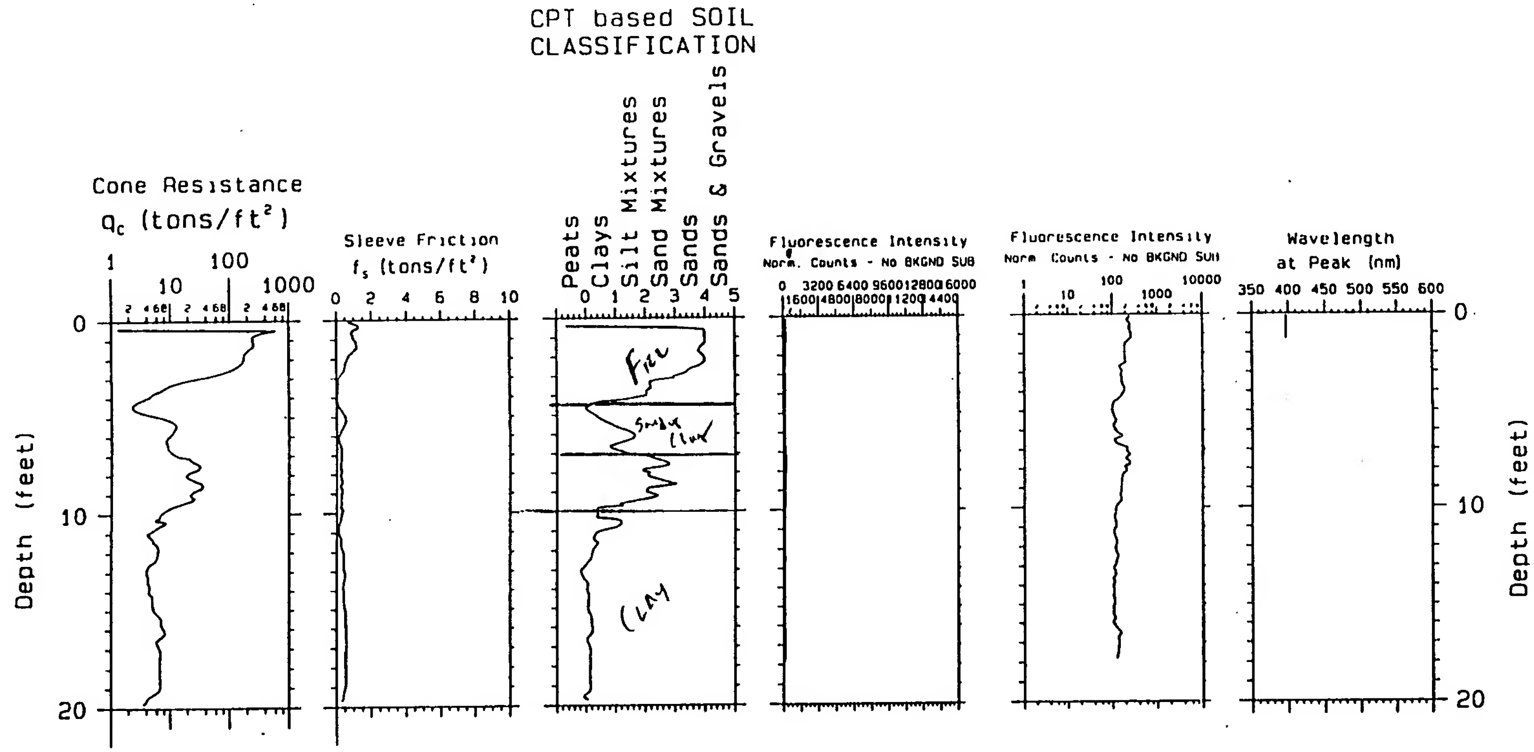
SCAPS

Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 20.12

CPT; 19EAK01



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

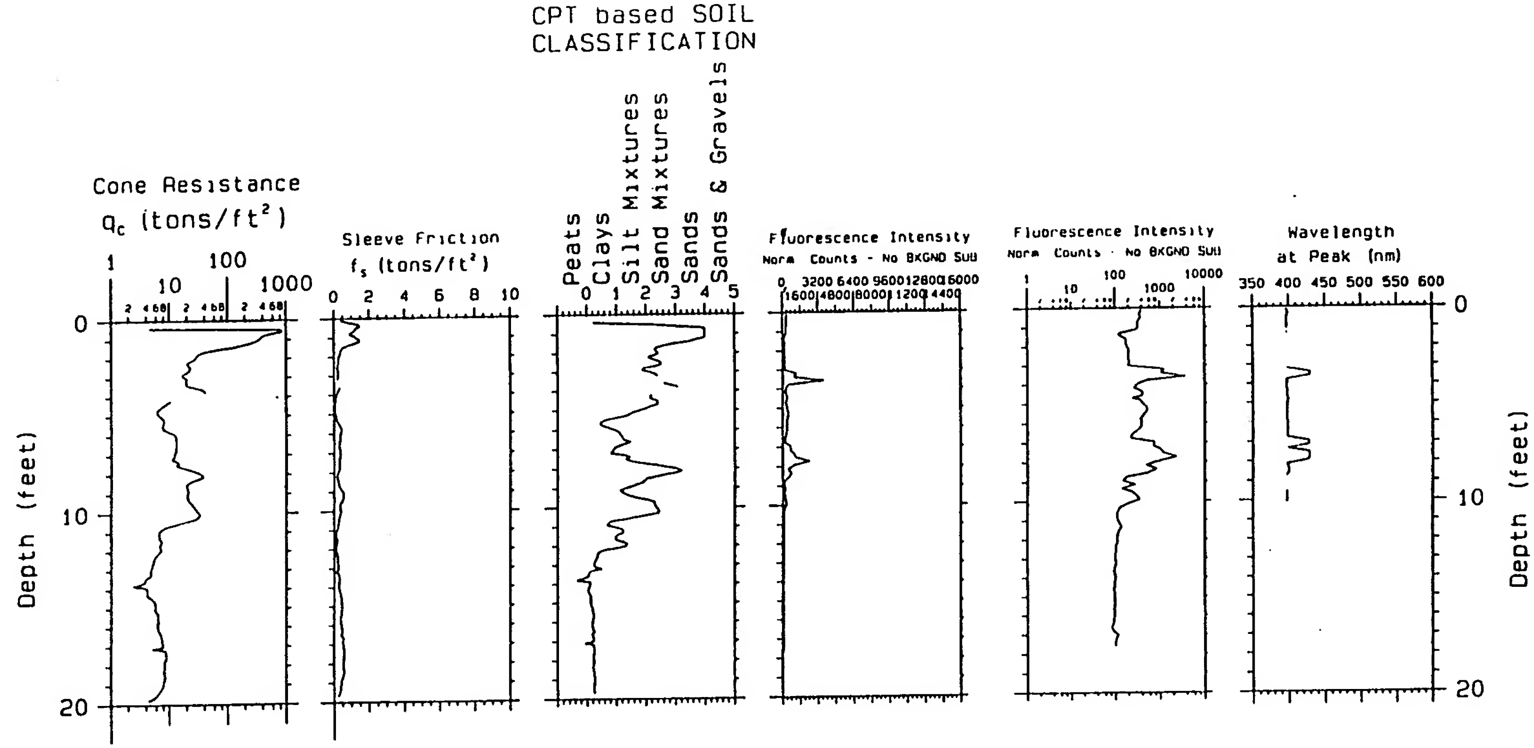
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 19.97

CPT; 20EAK01

Prob... e; 03-25-1995



Project; Eaker AFB

Probe Depth; 19.93

Laser induced fluorescence of POL via fiber optics

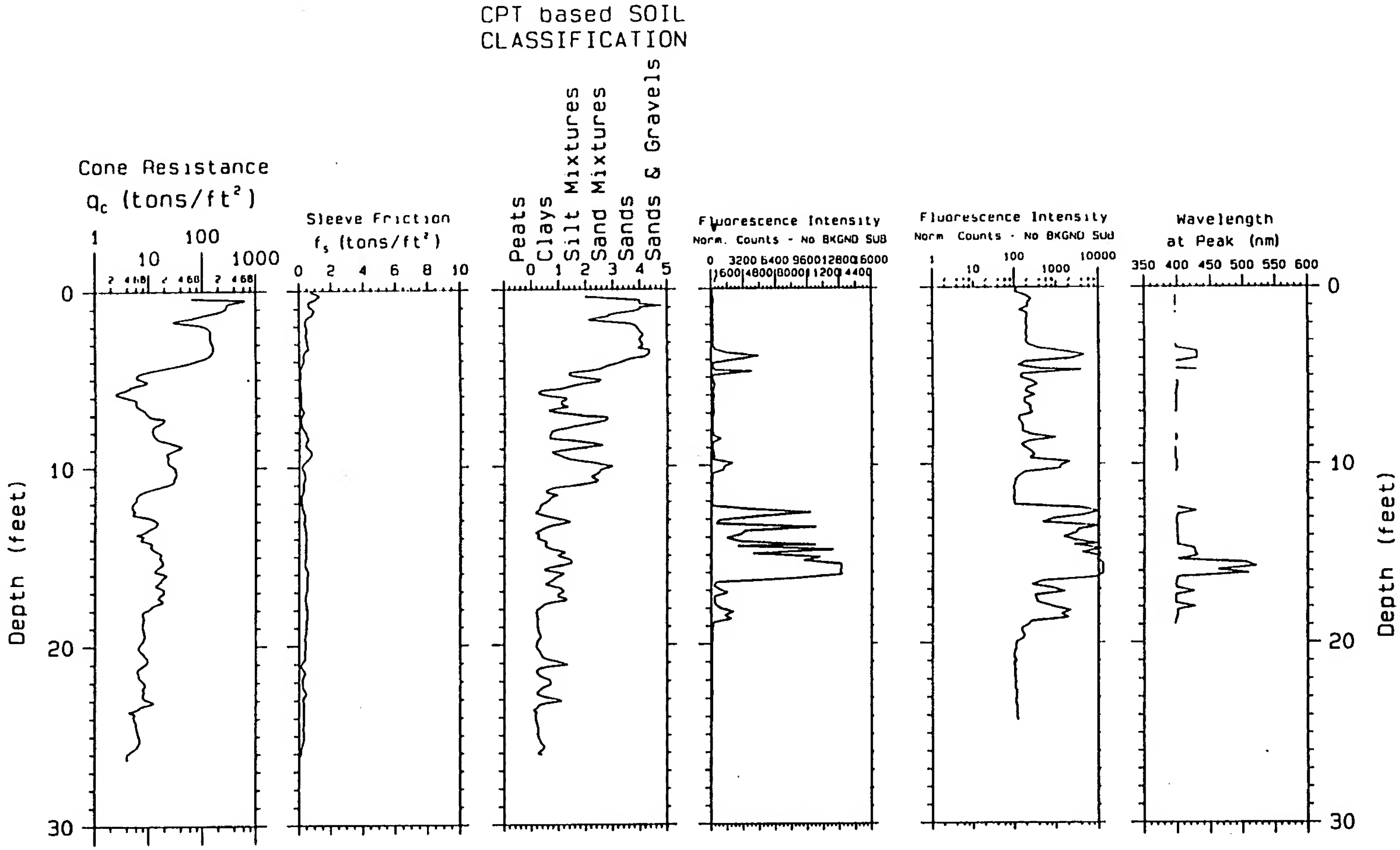
U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

CPT; 21EAK01

Probing date: 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

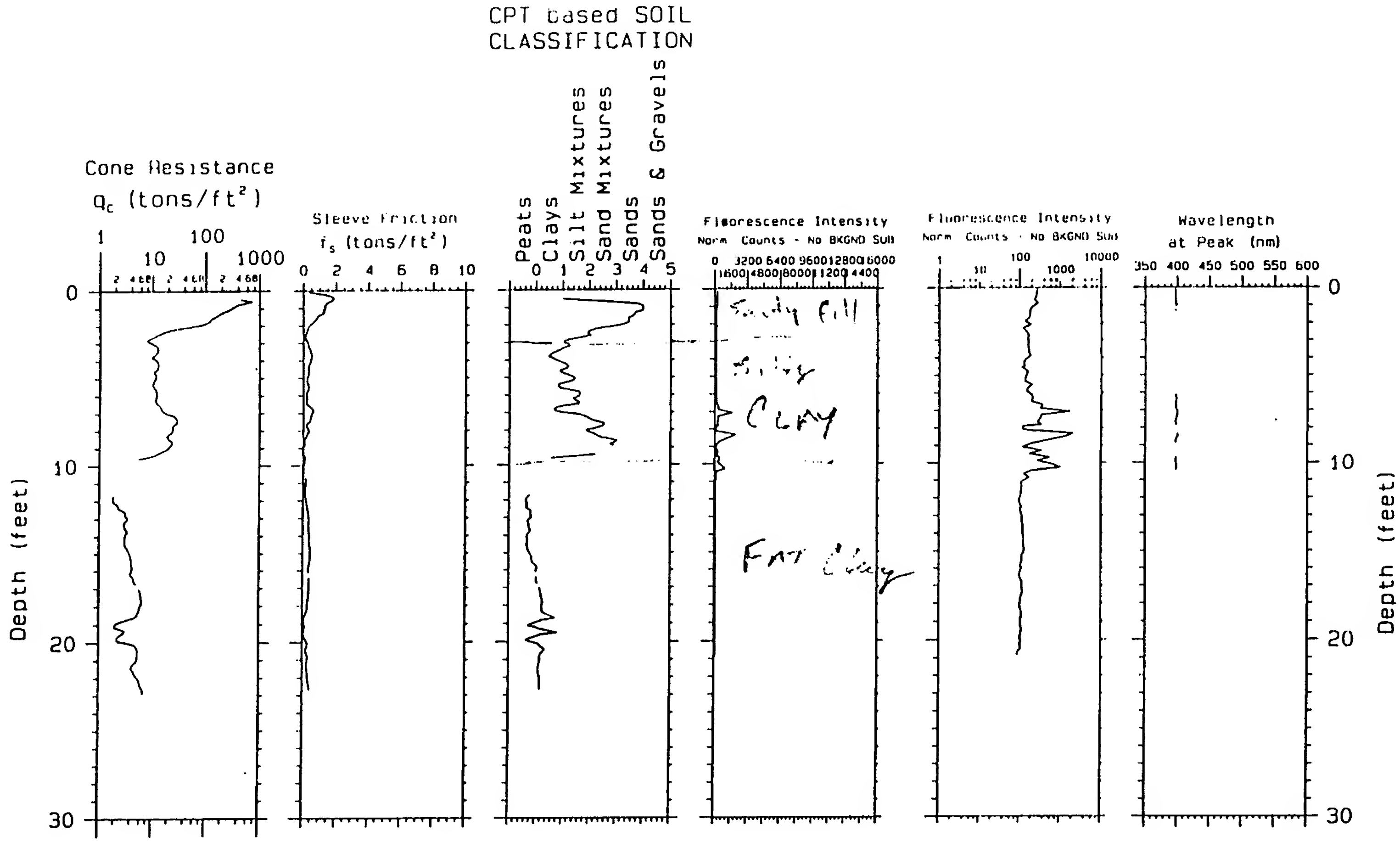
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 26.46

CPT; 22EAK01

Prob e; 03-25-1995



Probing date: 03-25-1995

Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

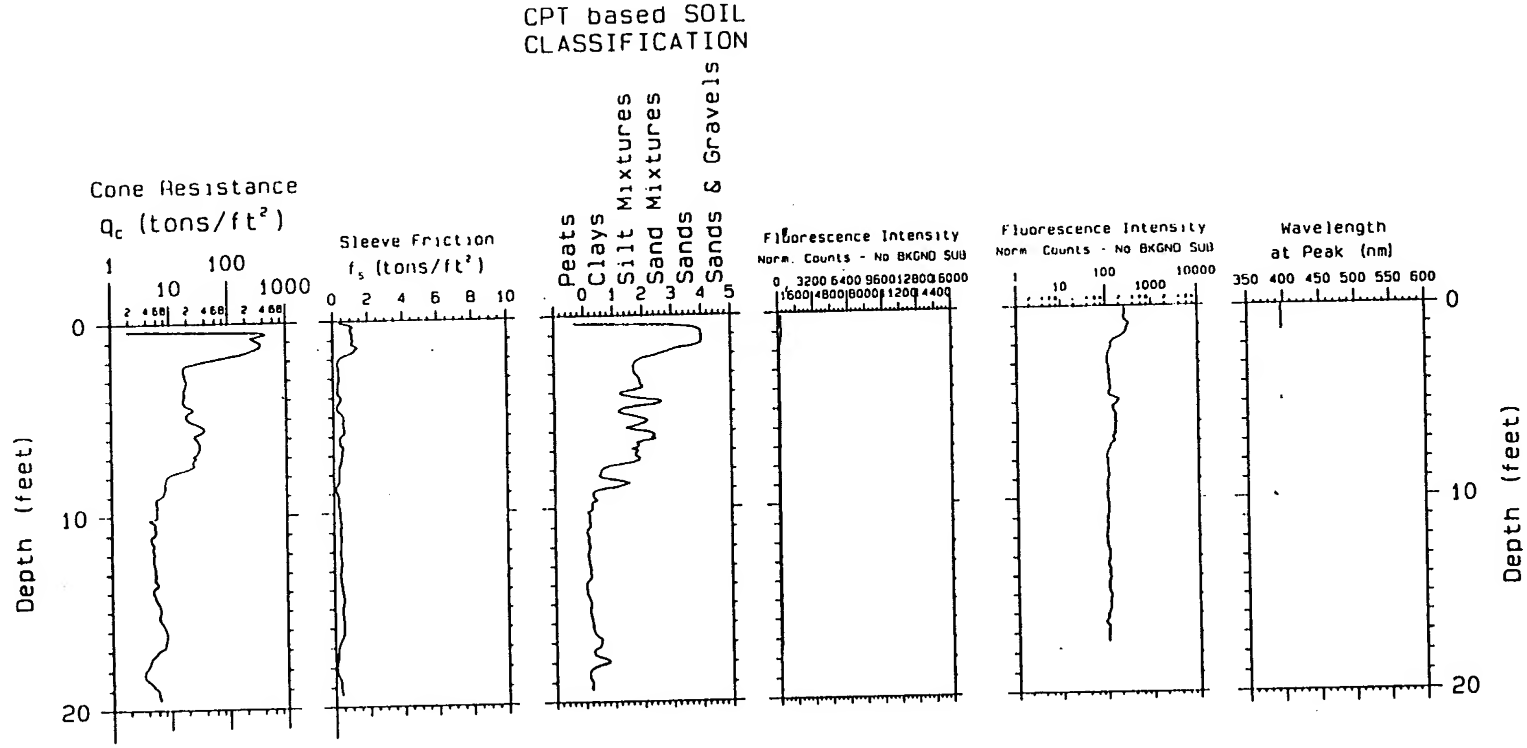
SCAPS

Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 23.07

CPT; 23EAK01



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

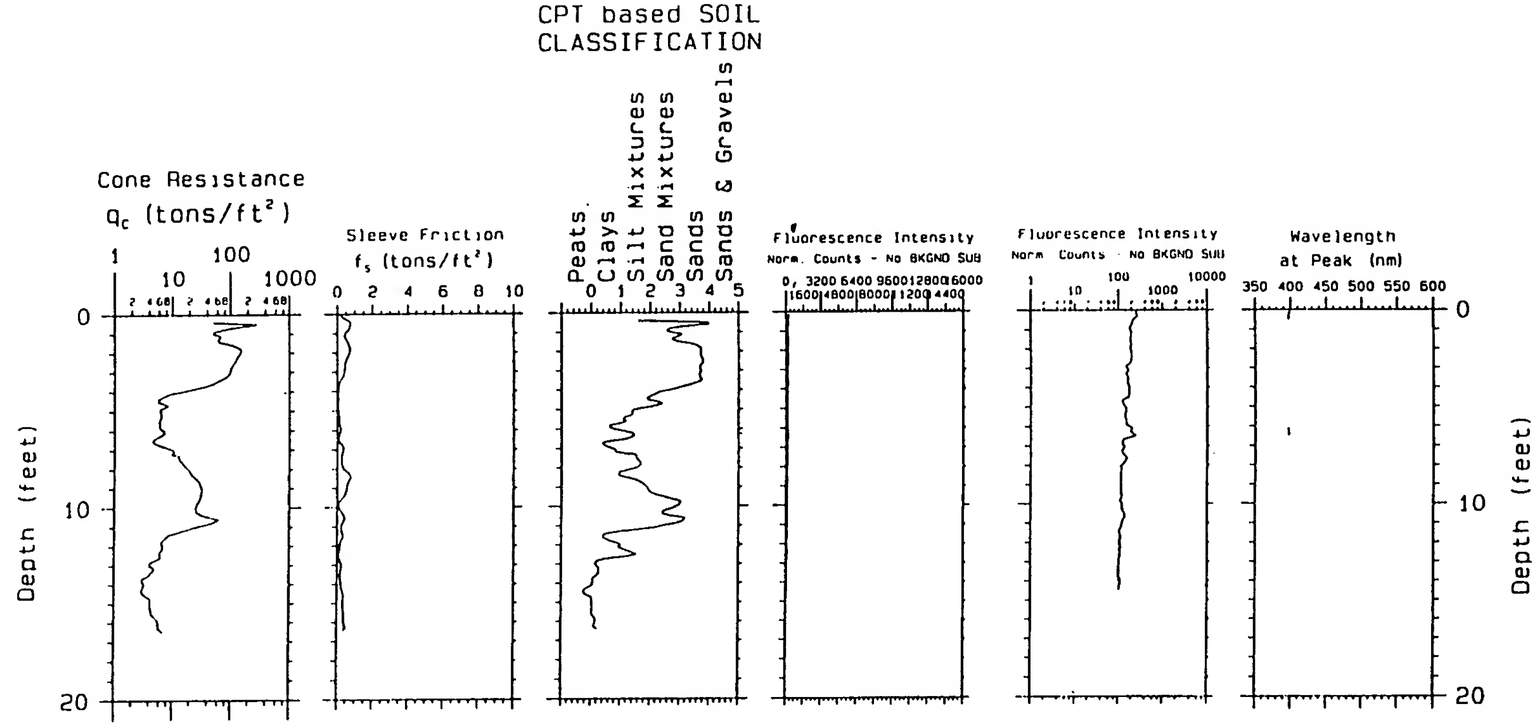
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 19.69

CPT; 24[illegible]K01

Prob[illegible]e; 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

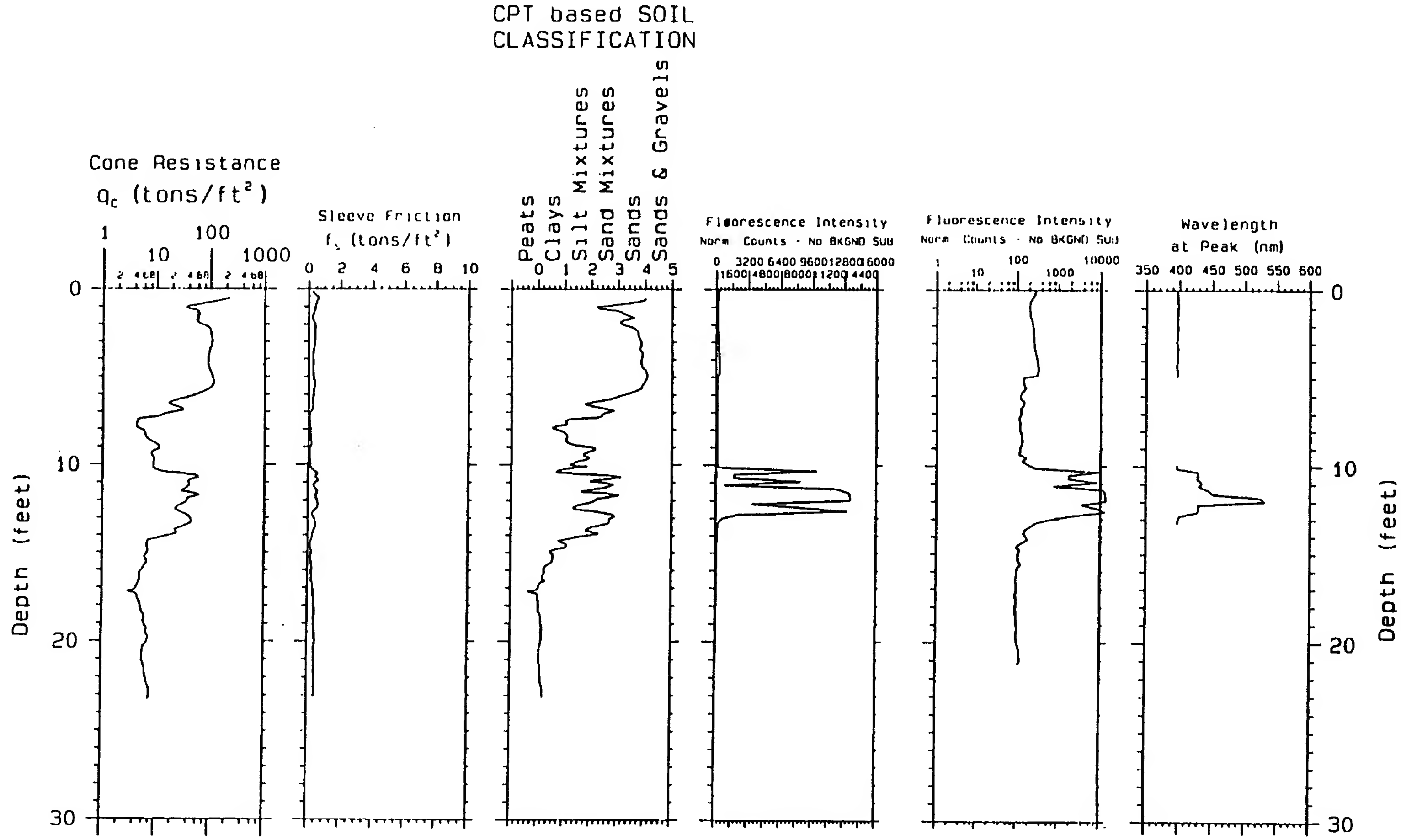
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 16.65

CPT; 25EAK01

Probing date; 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

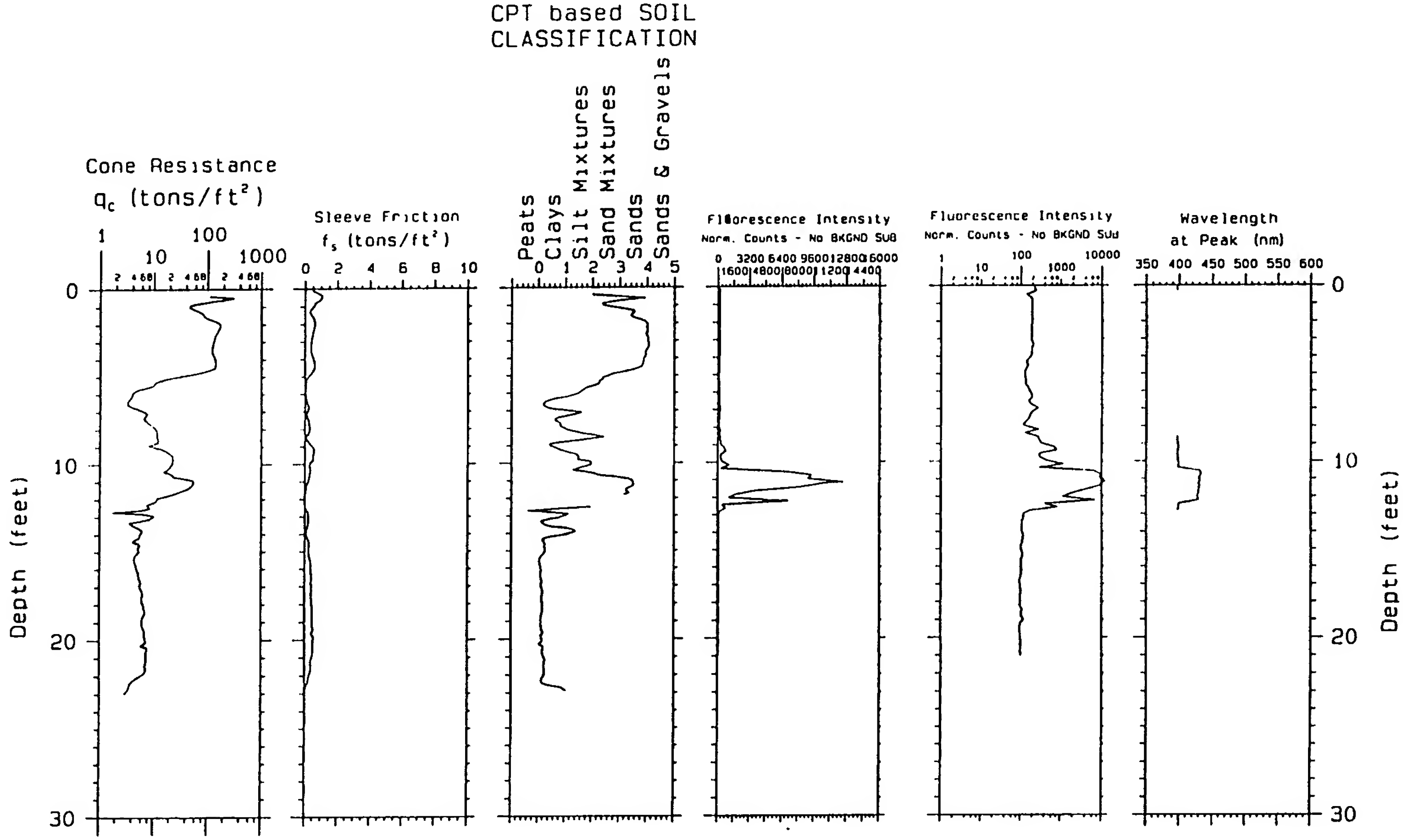
SCAPS Site Characterization and Analysis Penetrometer System

Prob : 03-25-1995

Project; Eaker AFB

Probe Depth; 23.40

CPT; 26 01



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

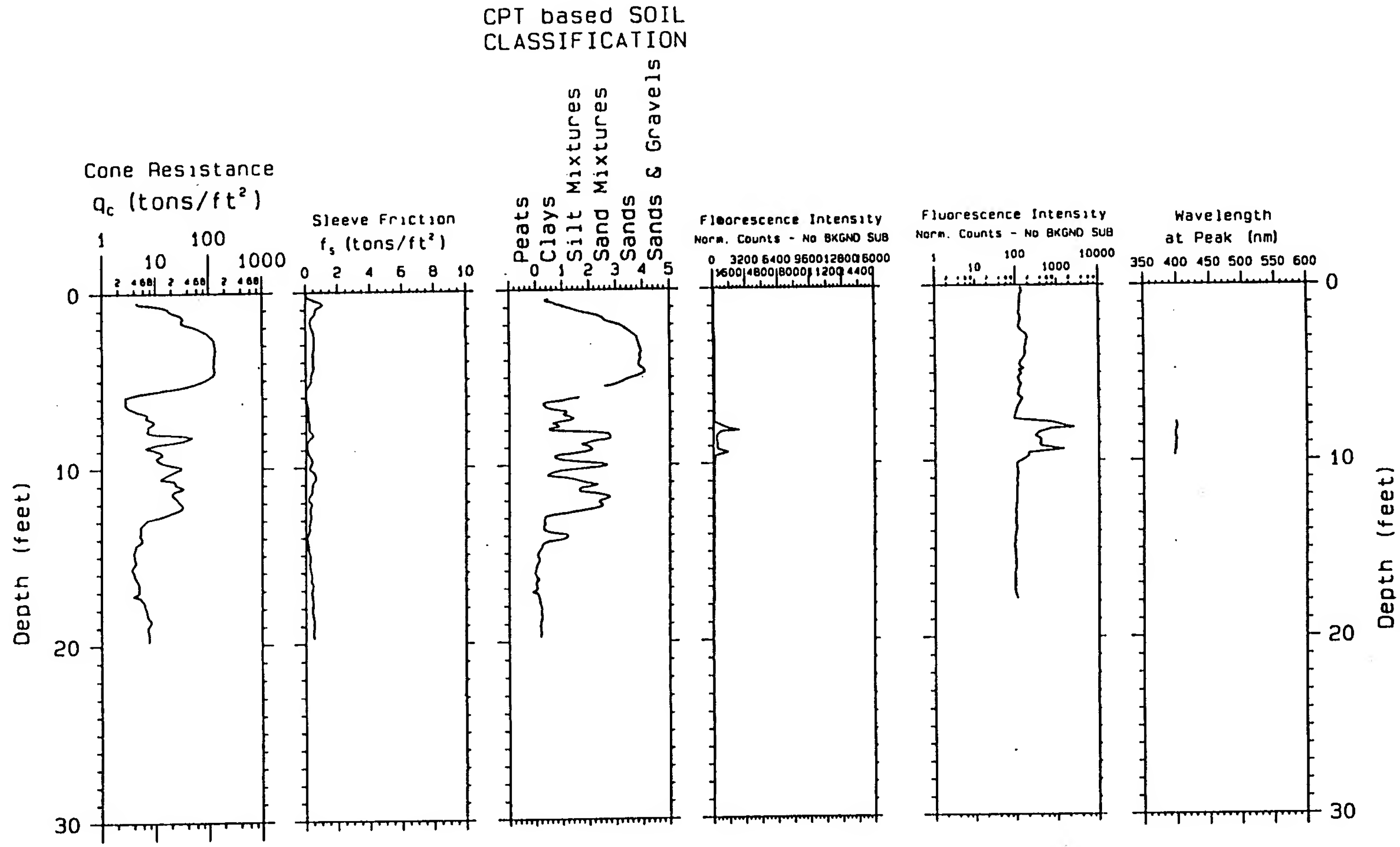
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 23.18

CPT; 27EAK01

Probing date; 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

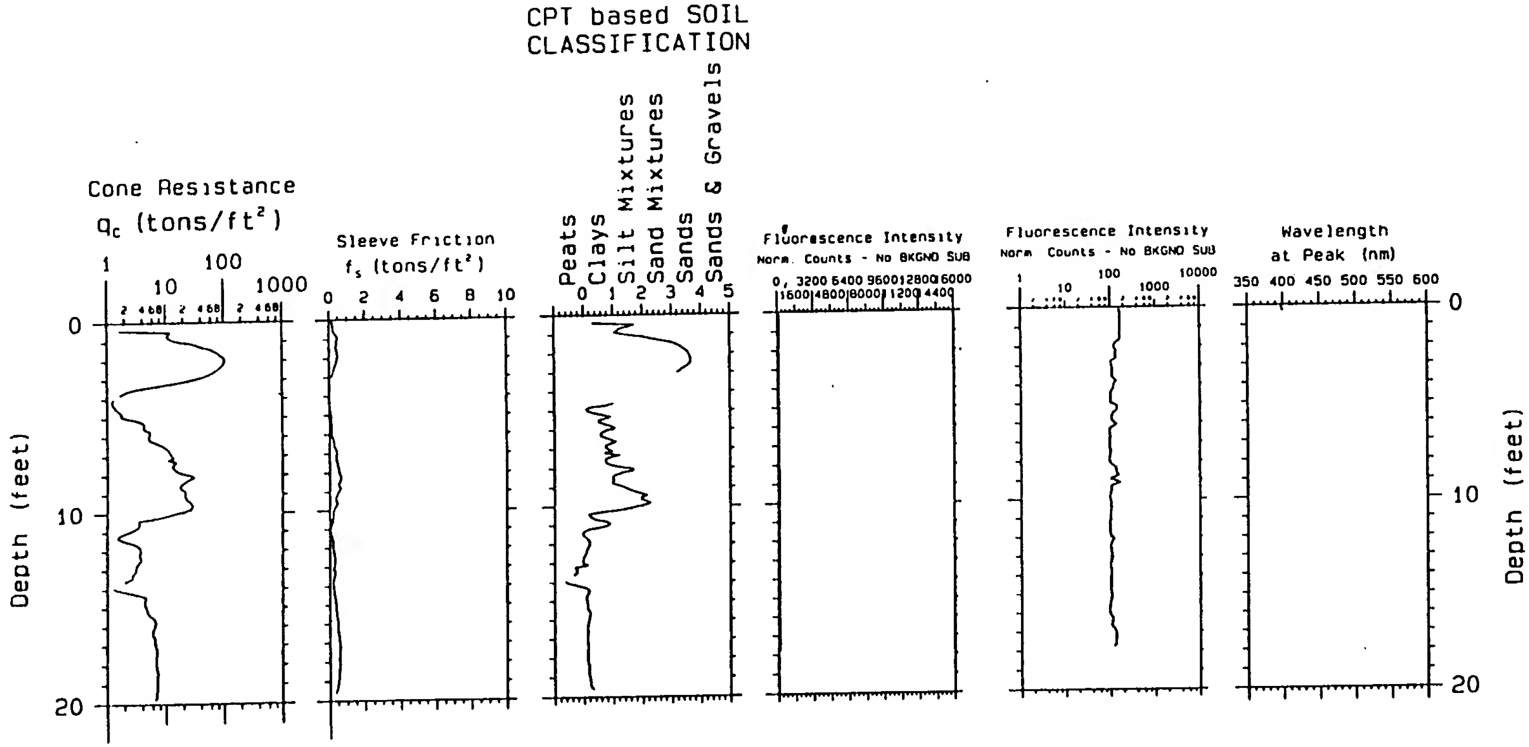
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 20.05

CPT; 28 ^K01

Prob e; 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

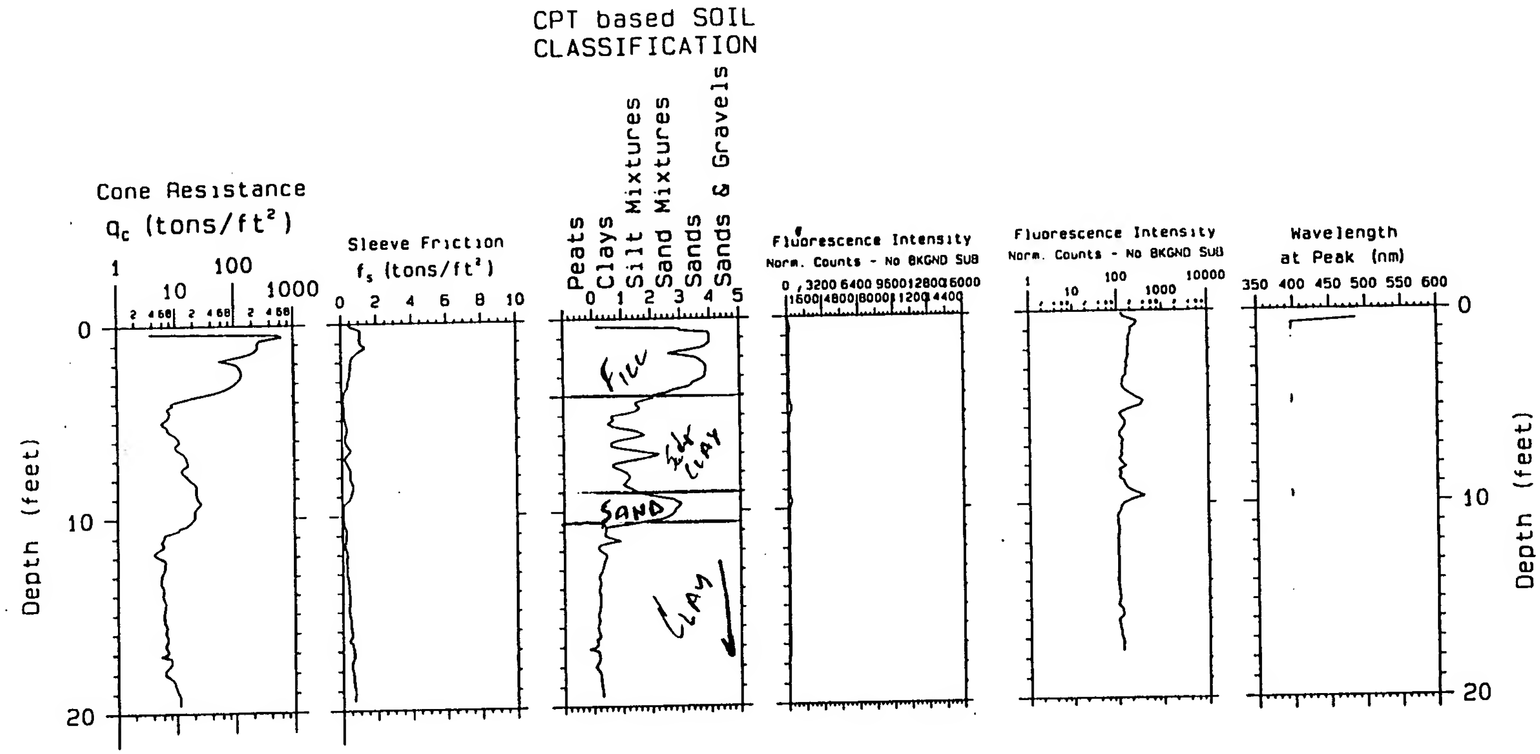
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 19.91

CPT; 29EAK01

Probing date: 03-25-1995



Project; Eaker AFB
Probe Depth; 19.76

Laser induced fluorescence of POL via fiber optics

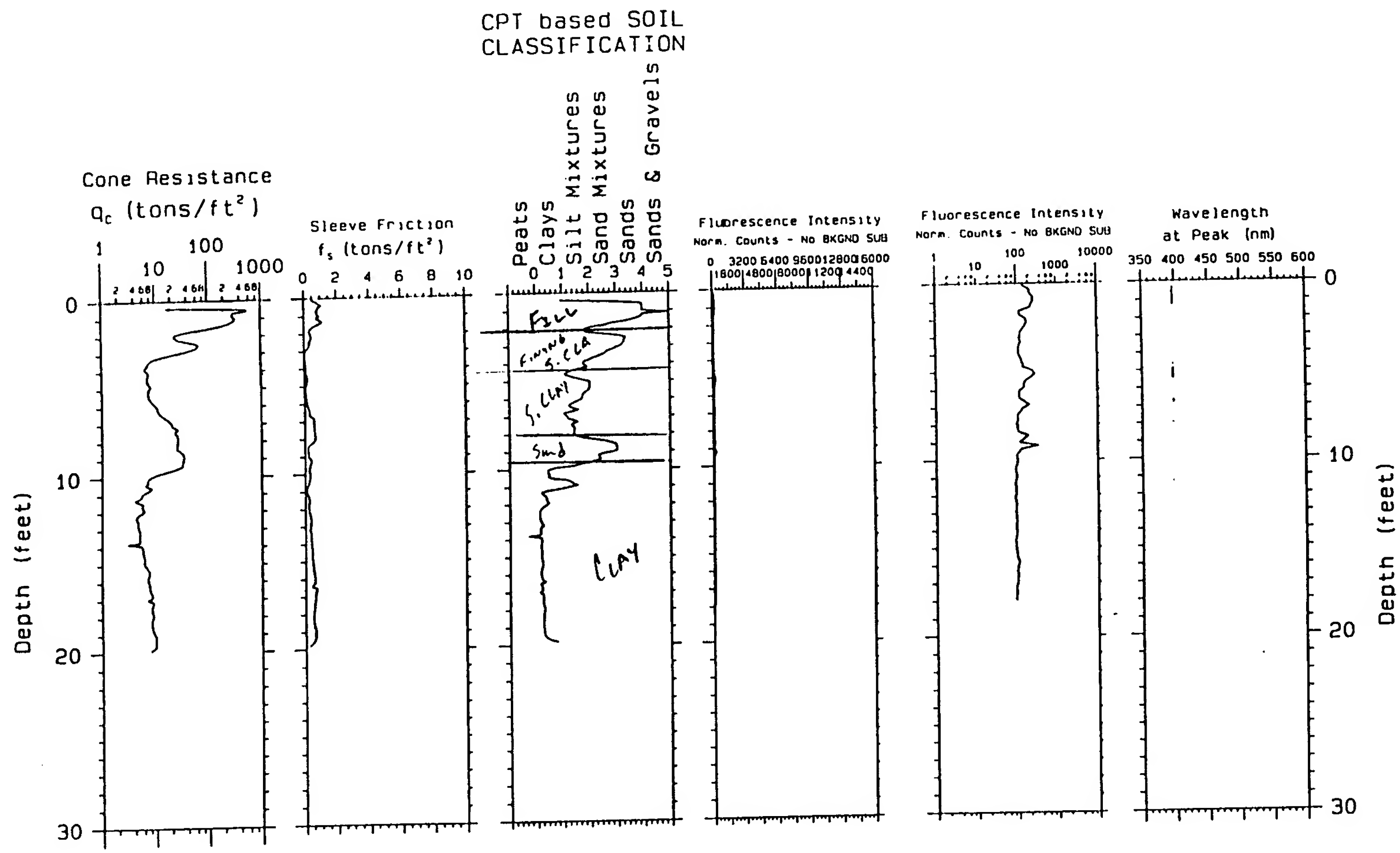
U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

CPT; 30 ^K01

Prob te; 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

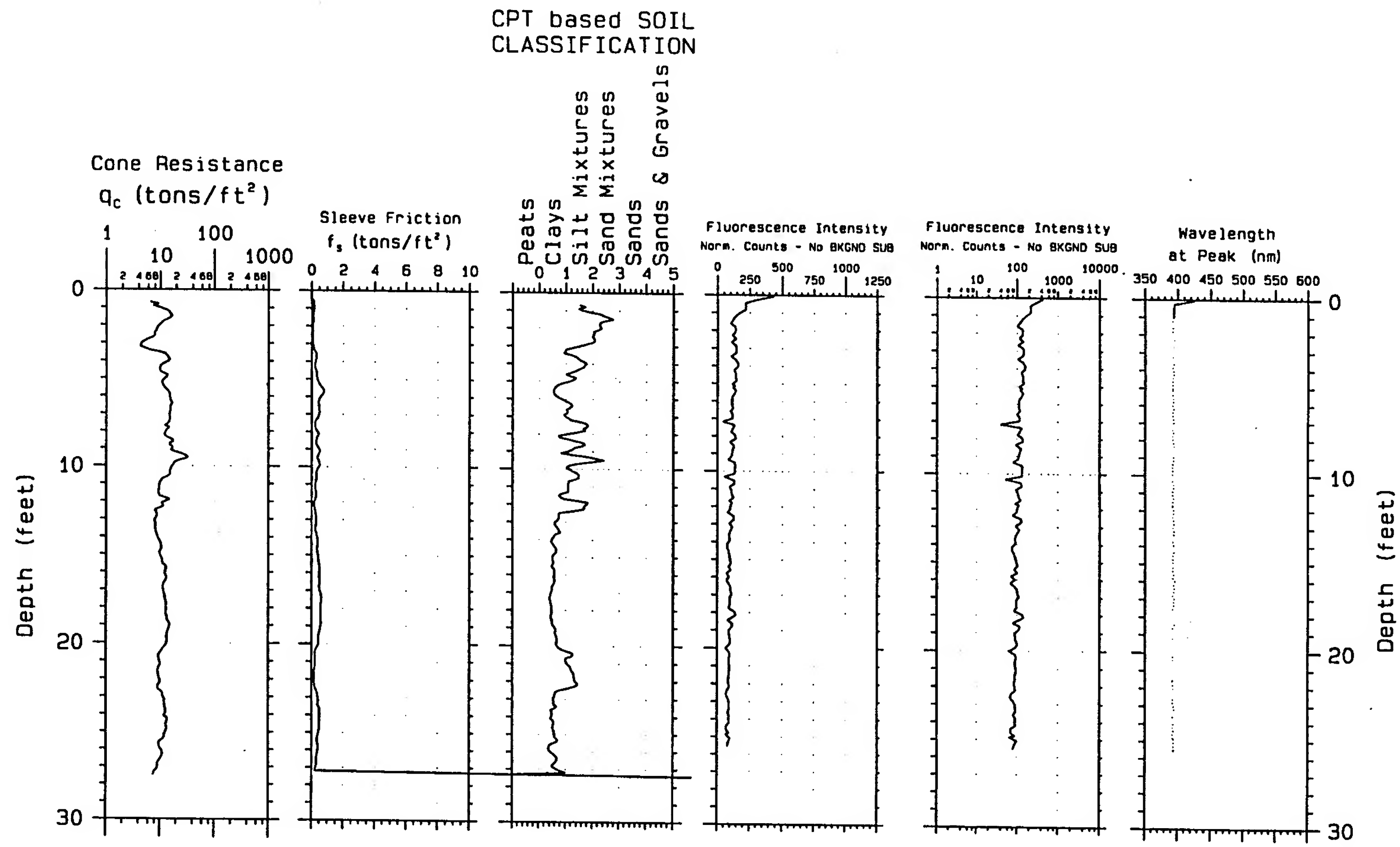
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB

Probe Depth; 20.12

CPT; 31EAK01

Probing date; 03-25-1995



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK

SCAPS

Site Characterization and Analysis Penetrometer System

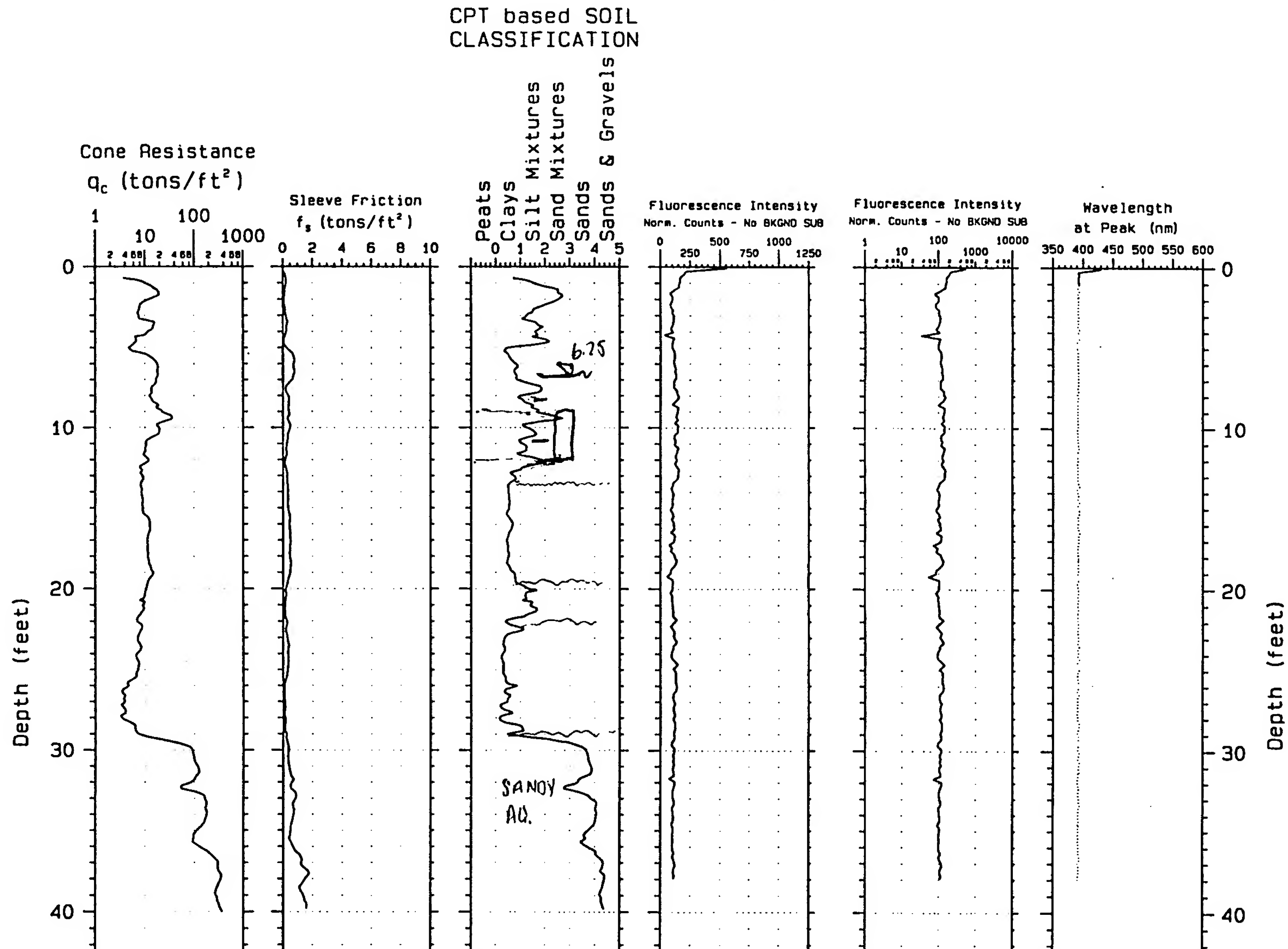
Project; Eaker AFB visit 4 <NEW>

Probe Depth; 27.70

Pre-Push Depth; 0

CPT; 1ES F

Prob ate; 03-26-1996



9-12
~~8-11~~
20-23
30-33

Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

Probing date: 03-26-1996

MRK SCAPS

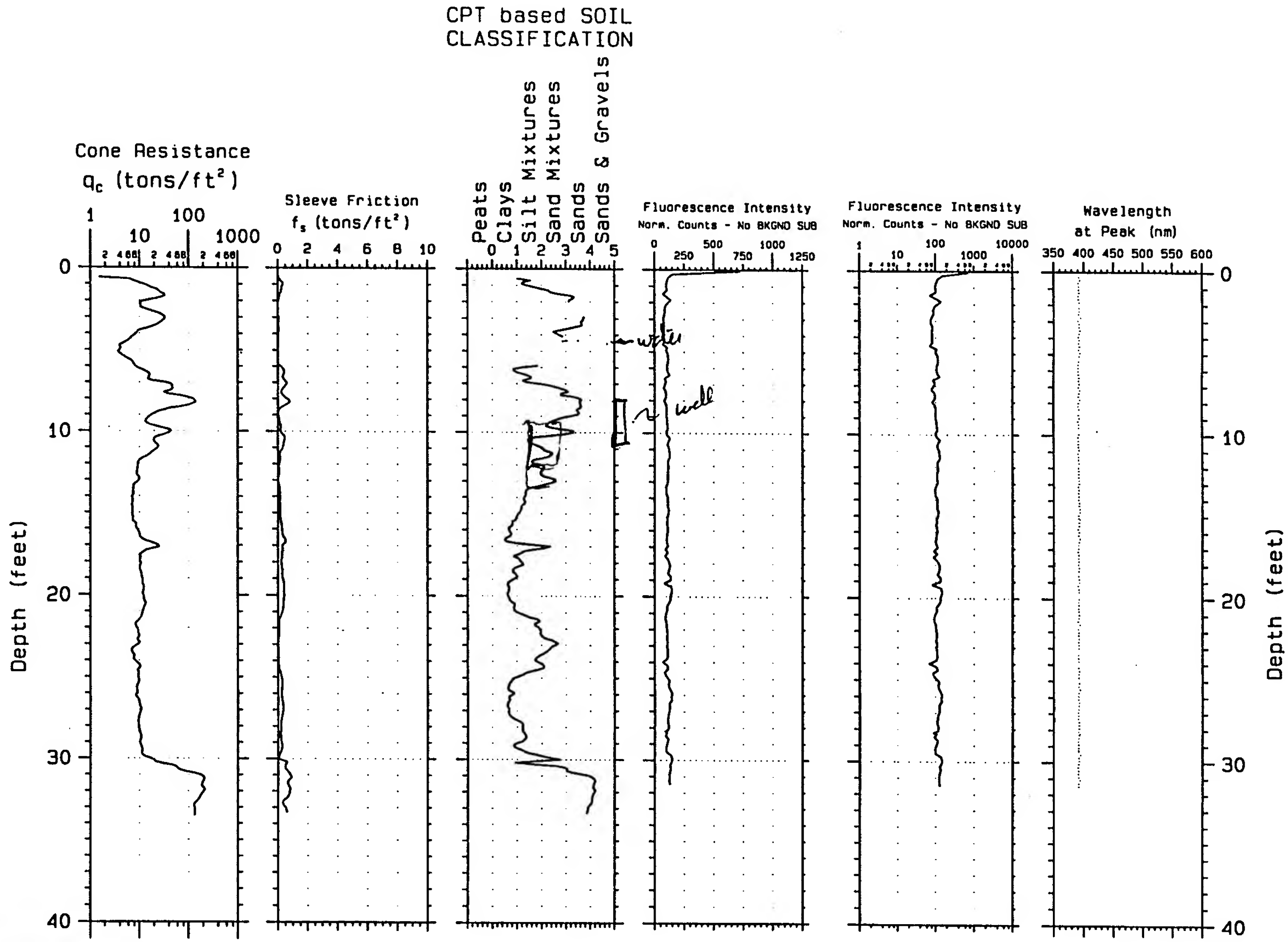
Site Characterization and Analysis Penetrometer System

Project: Eaker AFB visit 4

Probe Depth: 40.10

Pre-Push Depth: 0

CPT: 2ESLF



8-11

Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Eaker AFB visit 4

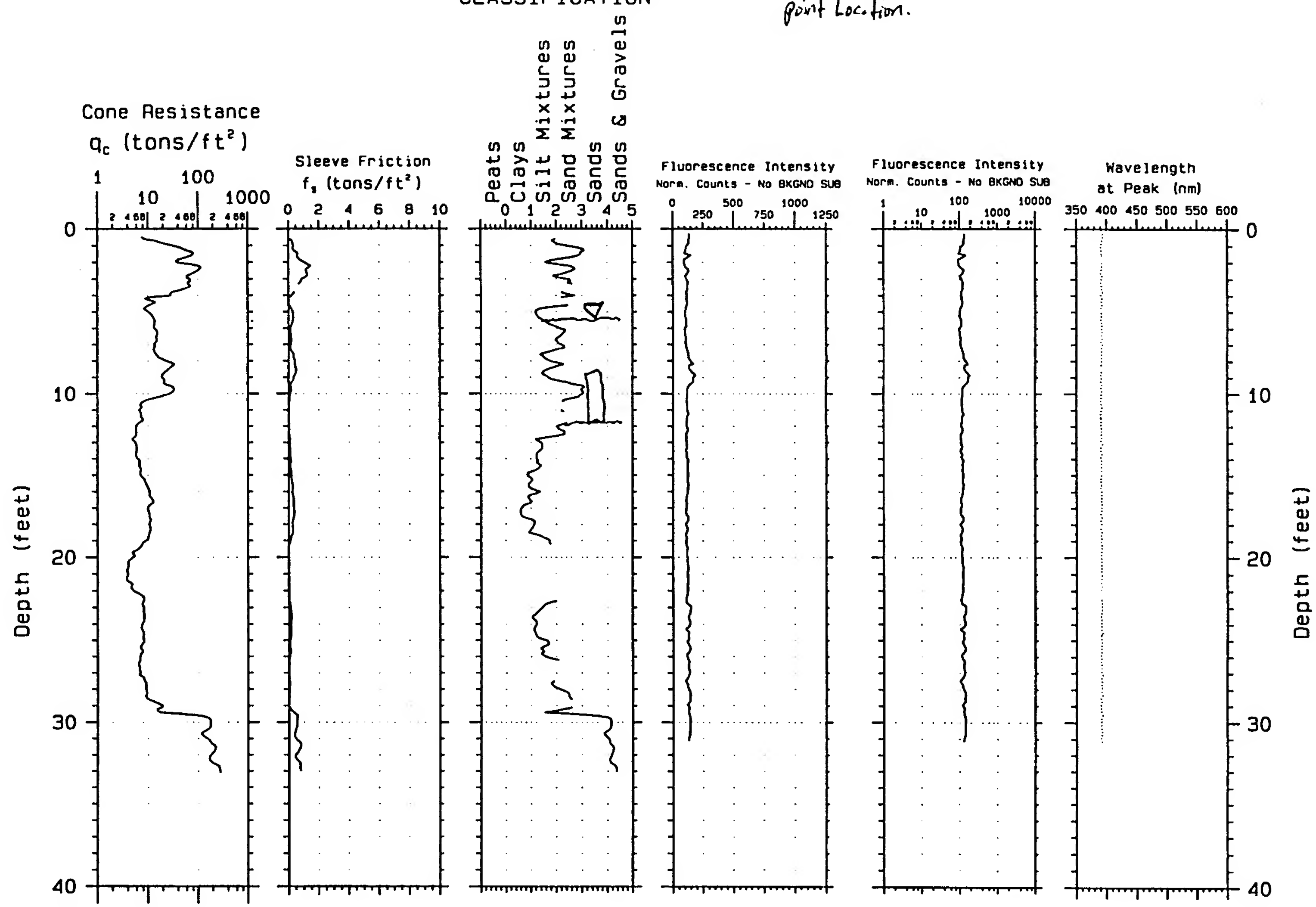
Probe Depth; 33.62

Pre-Push Depth; 0

CPT; 3ESLF

Prob e; 03-26-1996

optional groundwater point Location.



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK SCAPS

Site Characterization and Analysis Penetrometer System

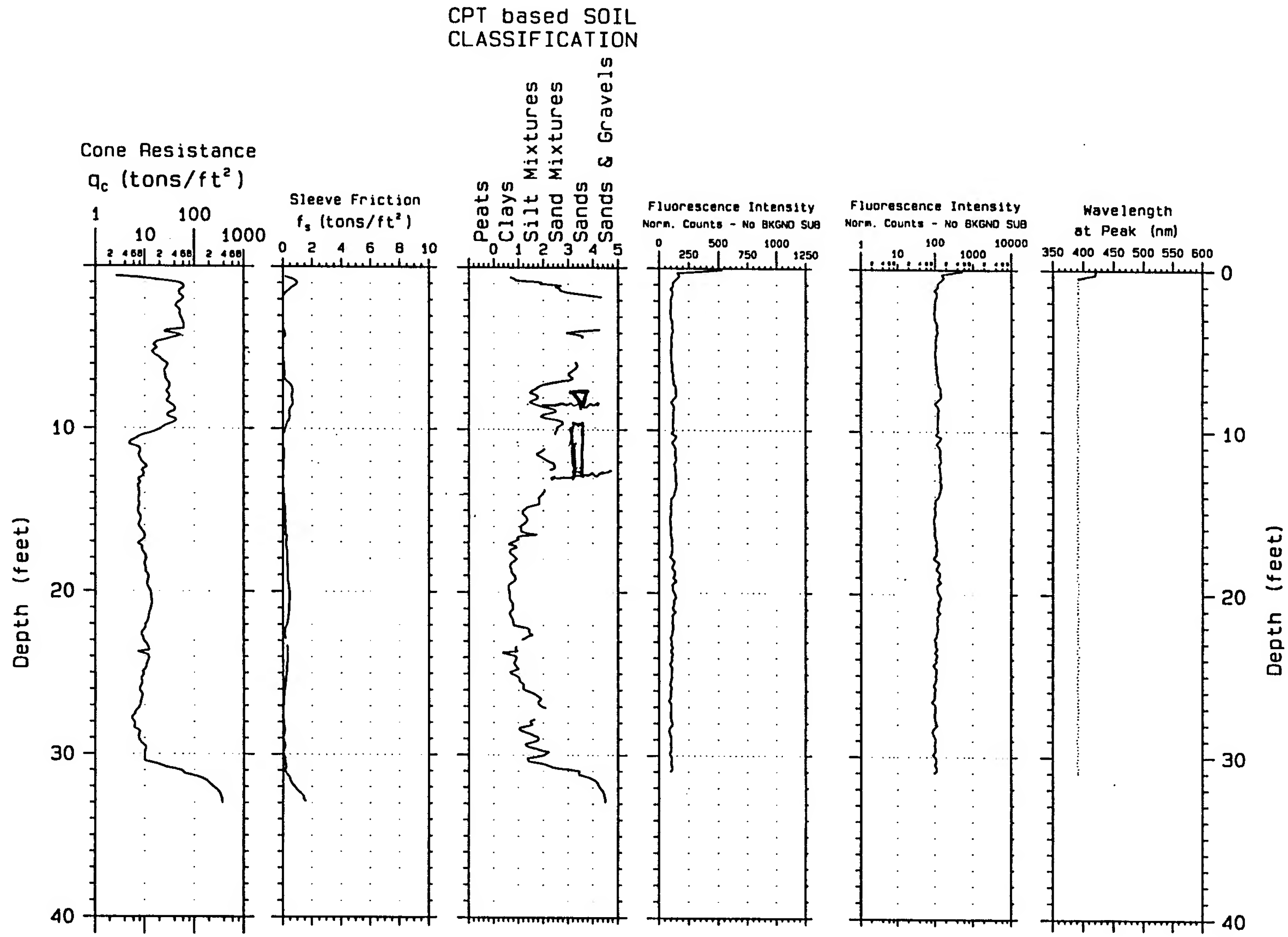
Project; Eaker AFB visit 4

Probe Depth; 33.28

Pre-Push Depth; 0

CPT; 4ESLF

Probing date; 03-26-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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SCAPS

Site Characterization and Analysis Penetrometer System

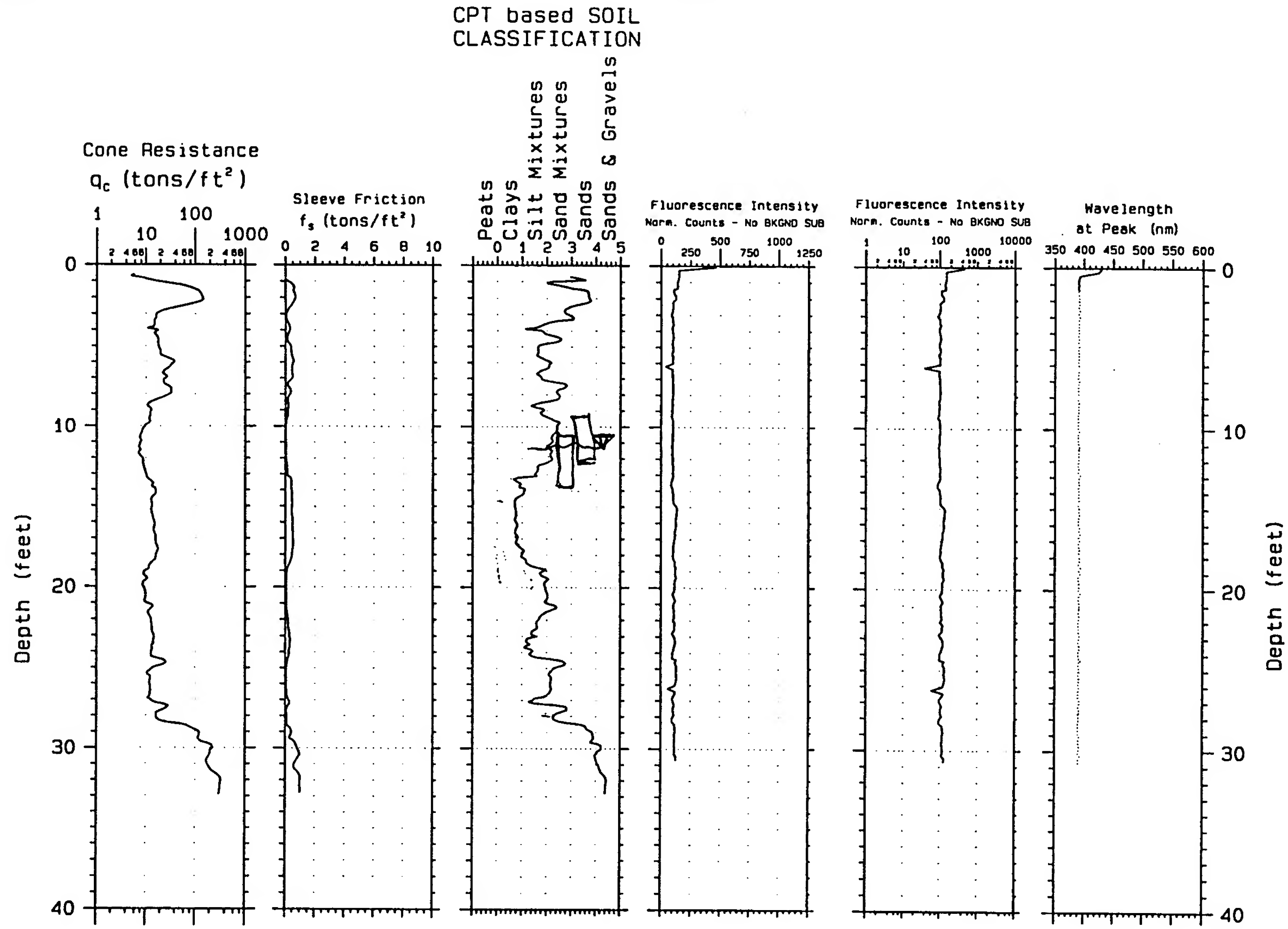
Project; Eaker AFB visit 4

Probe Depth; 33.14

Pre-Push Depth; 0

CPT; 5ES F

Probi e; 03-26-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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SCAPS

Site Characterization and Analysis Penetrometer System

Project; Eaker AFB visit 4

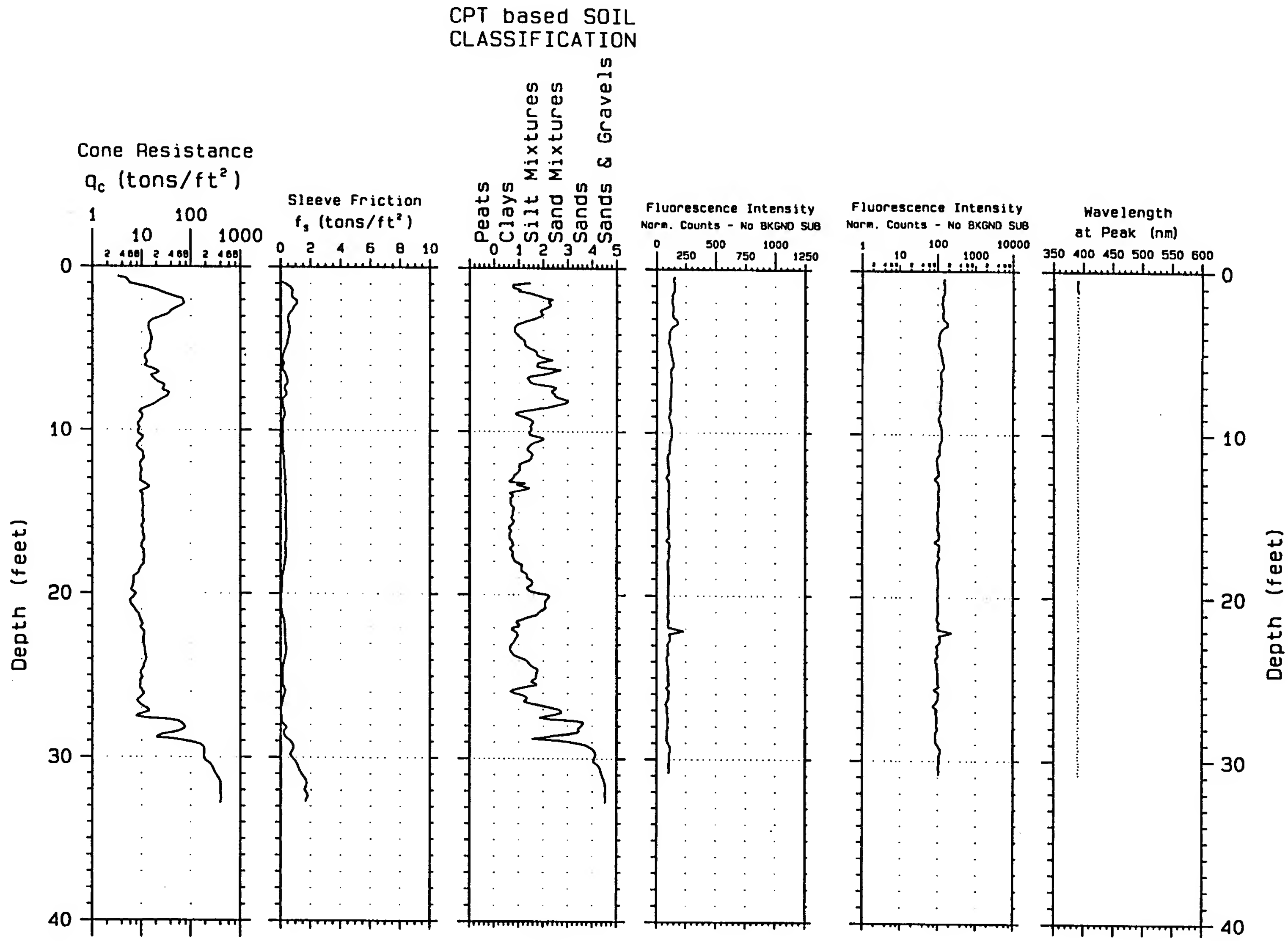
Probe Depth; 33.04

Pre-Push Depth; 0

CPT; 6ESLF

Probing date; 03-26-1996

0-13 9-12



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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Site Characterization and Analysis Penetrometer System

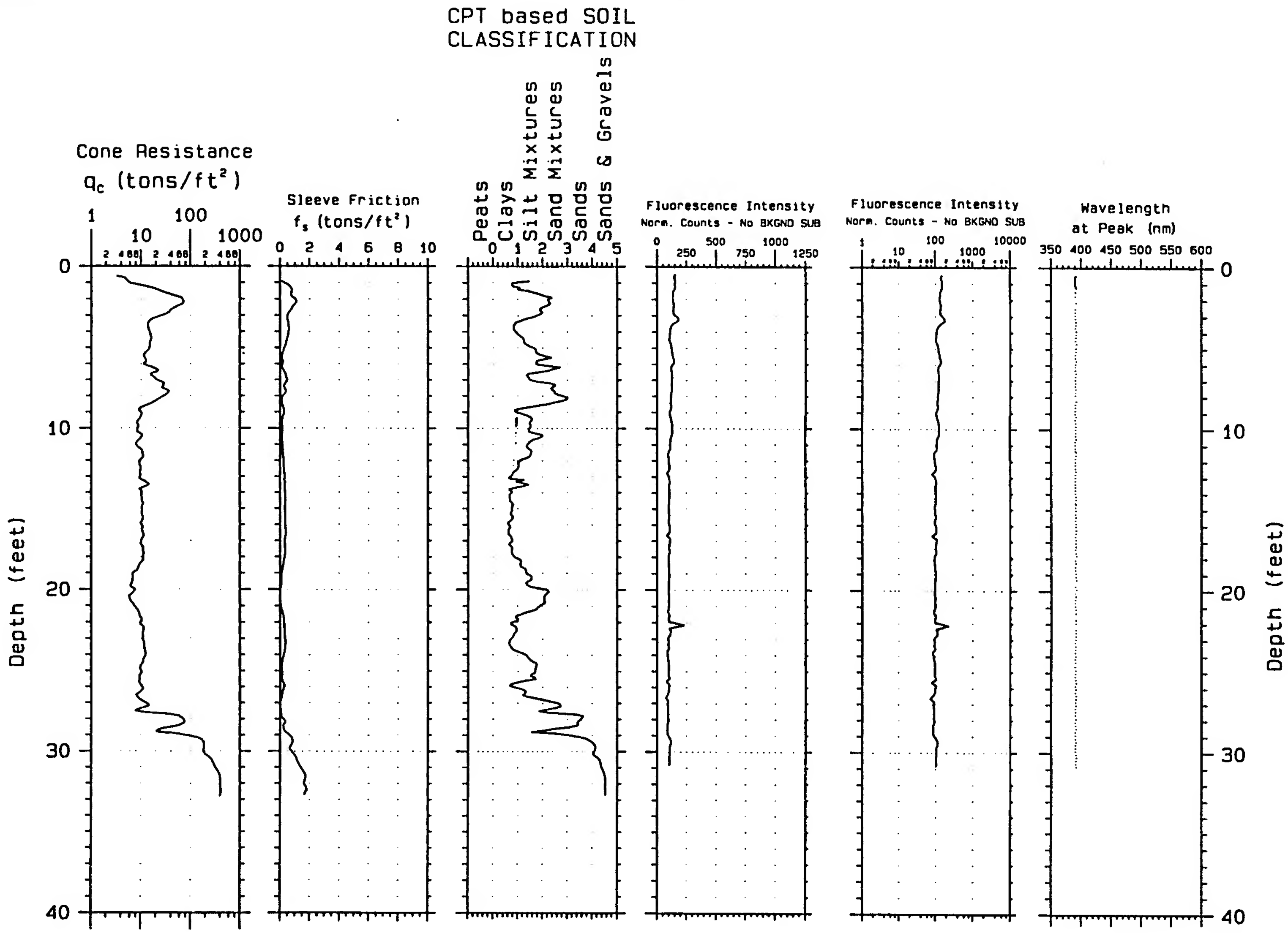
Project; Eaker AFB visit 4

Probe Depth; 33.03

Pre-Push Depth; 0

CPT; 7E F

Prob te; 03-26-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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Site Characterization and Analysis Penetrometer System

Project; Eaker AFB visit 4

Probe Depth; 33.03

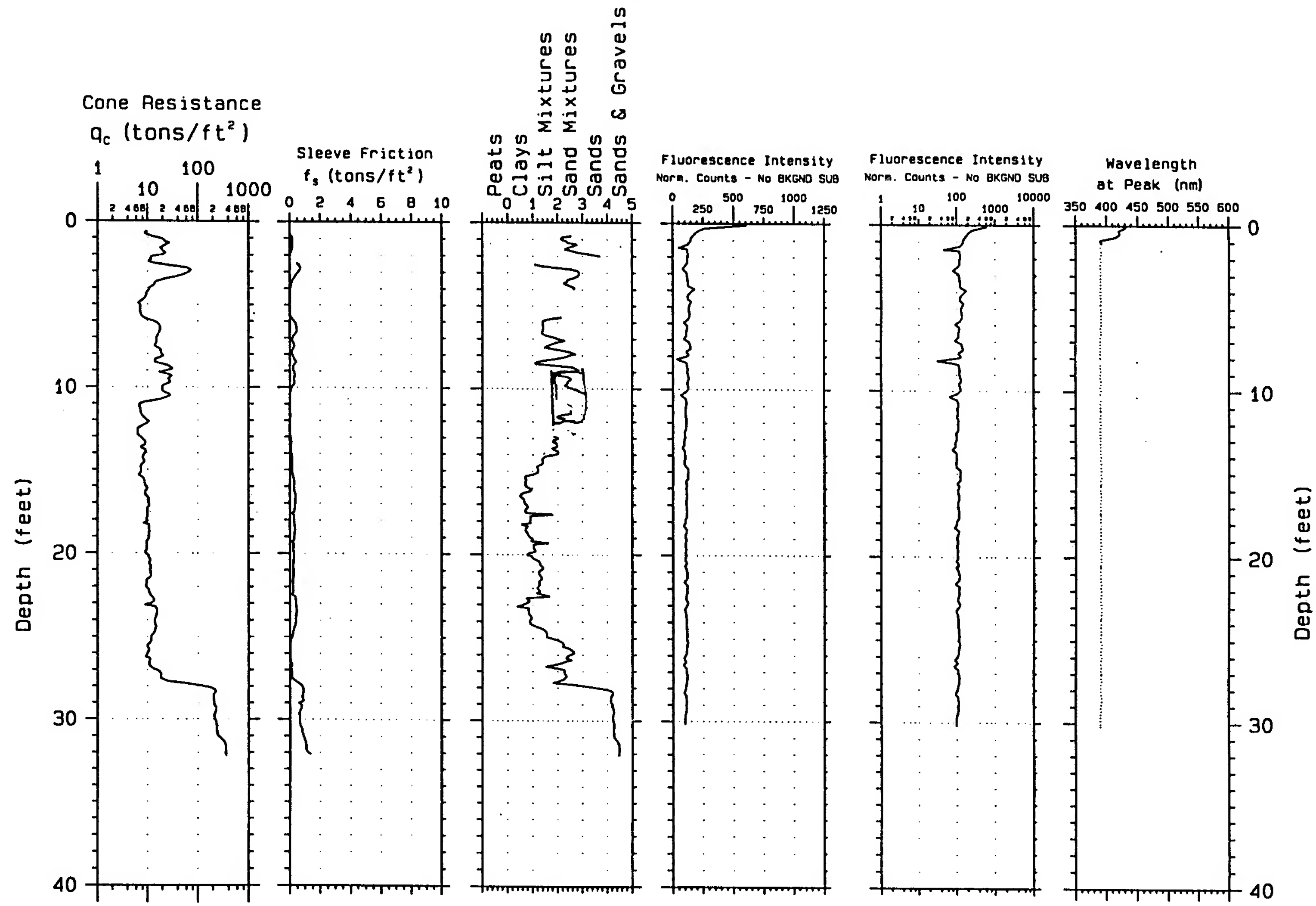
Pre-Push Depth; 0

CPT; 7ESLF

Probing date; 03-26-1996

4-12

Estimate well depth ~3-13' bgs



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

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SCAPS

Site Characterization and Analysis Penetrometer System

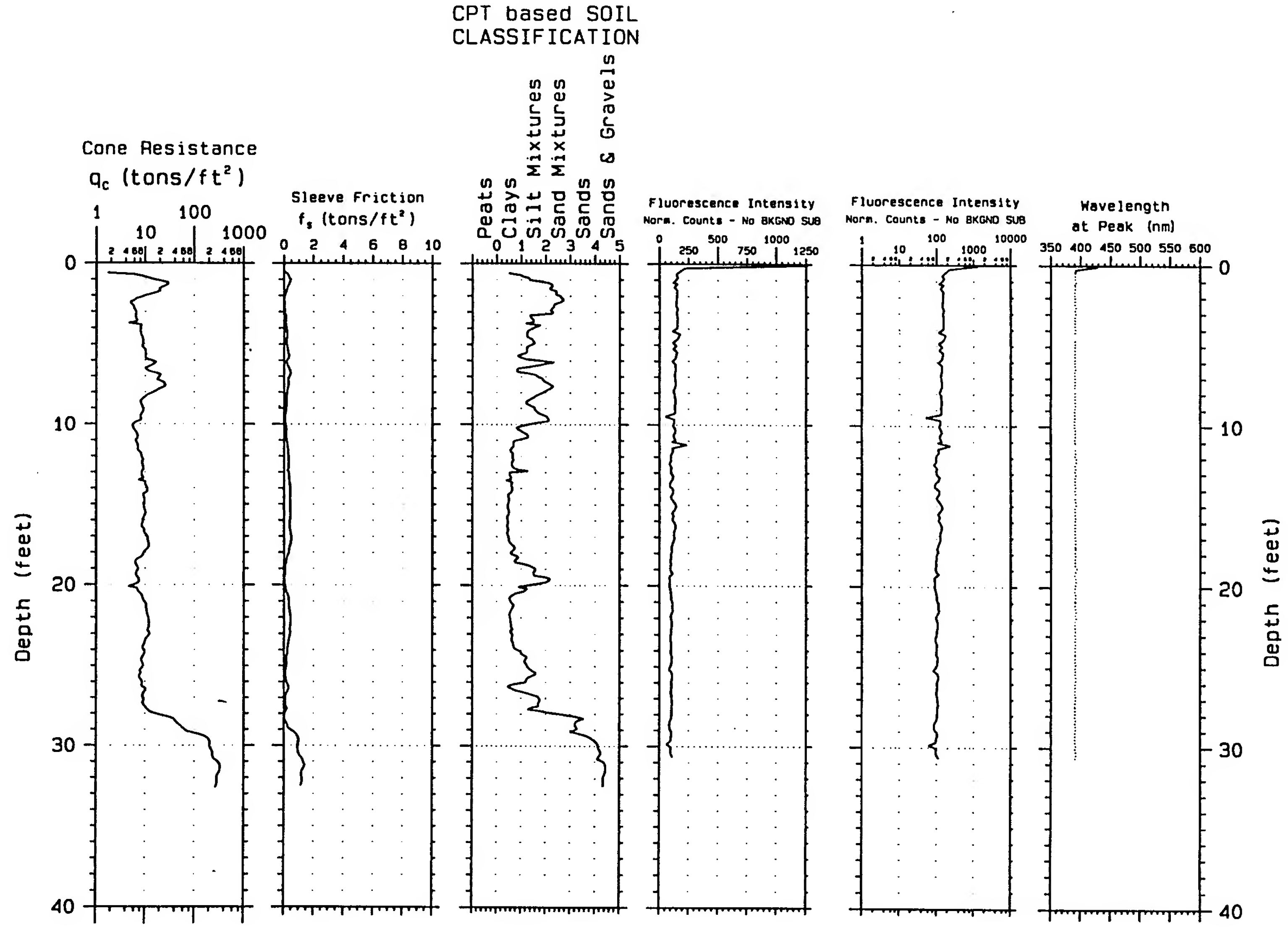
Project; Eaker AFB visit 4

Probe Depth; 32.33

Pre-Push Depth; 0

CPT; 8ESLF

Probe Date; 03-26-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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SCAPS

Site Characterization and Analysis Penetrometer System

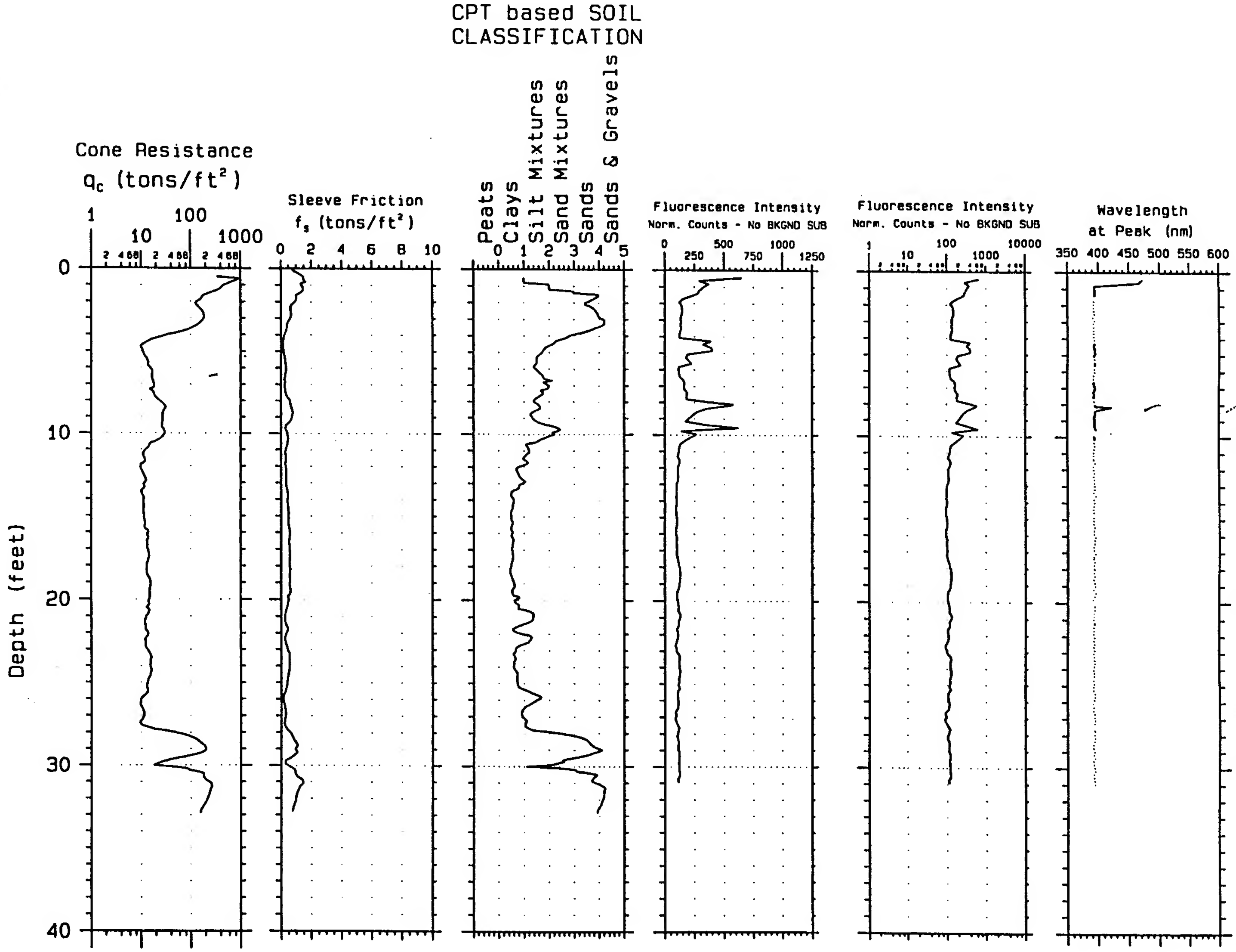
Project; Eaker AFB visit 4

Probe Depth; 32.79

Pre-Push Depth; 0

CPT; 9ESLF

Probing date; 03-26-1996



possible motor fuel.
- Diesel, or an oil
- According to Jim Campbell of the Army Corps

Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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Site Characterization and Analysis Penetrometer System

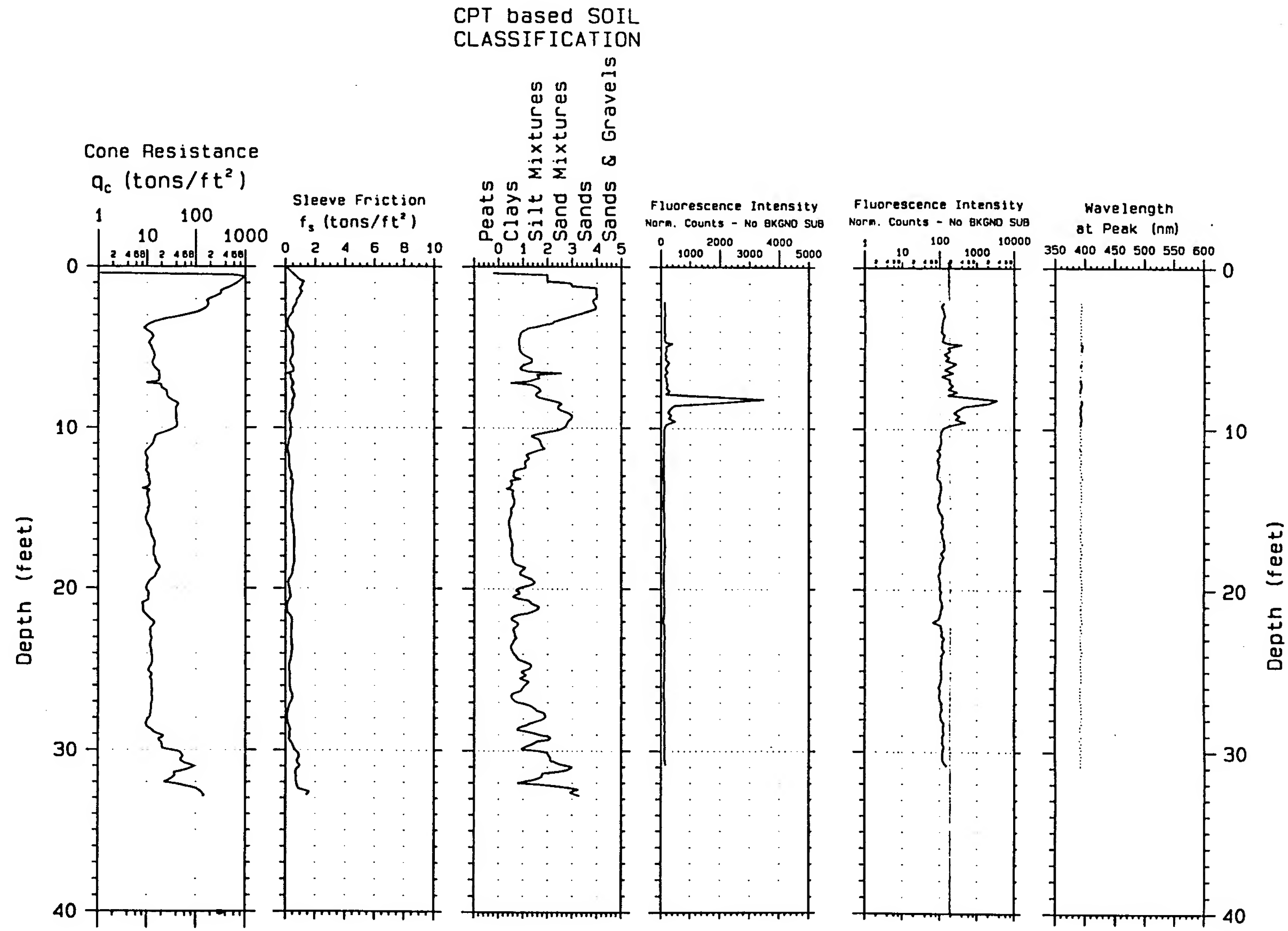
Project; Eaker AFB visit 4

Probe Depth; 33.15

Pre-Push Depth; 0

CPT; 10F LF

Prob te; 03-27-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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Site Characterization and Analysis Penetrometer System

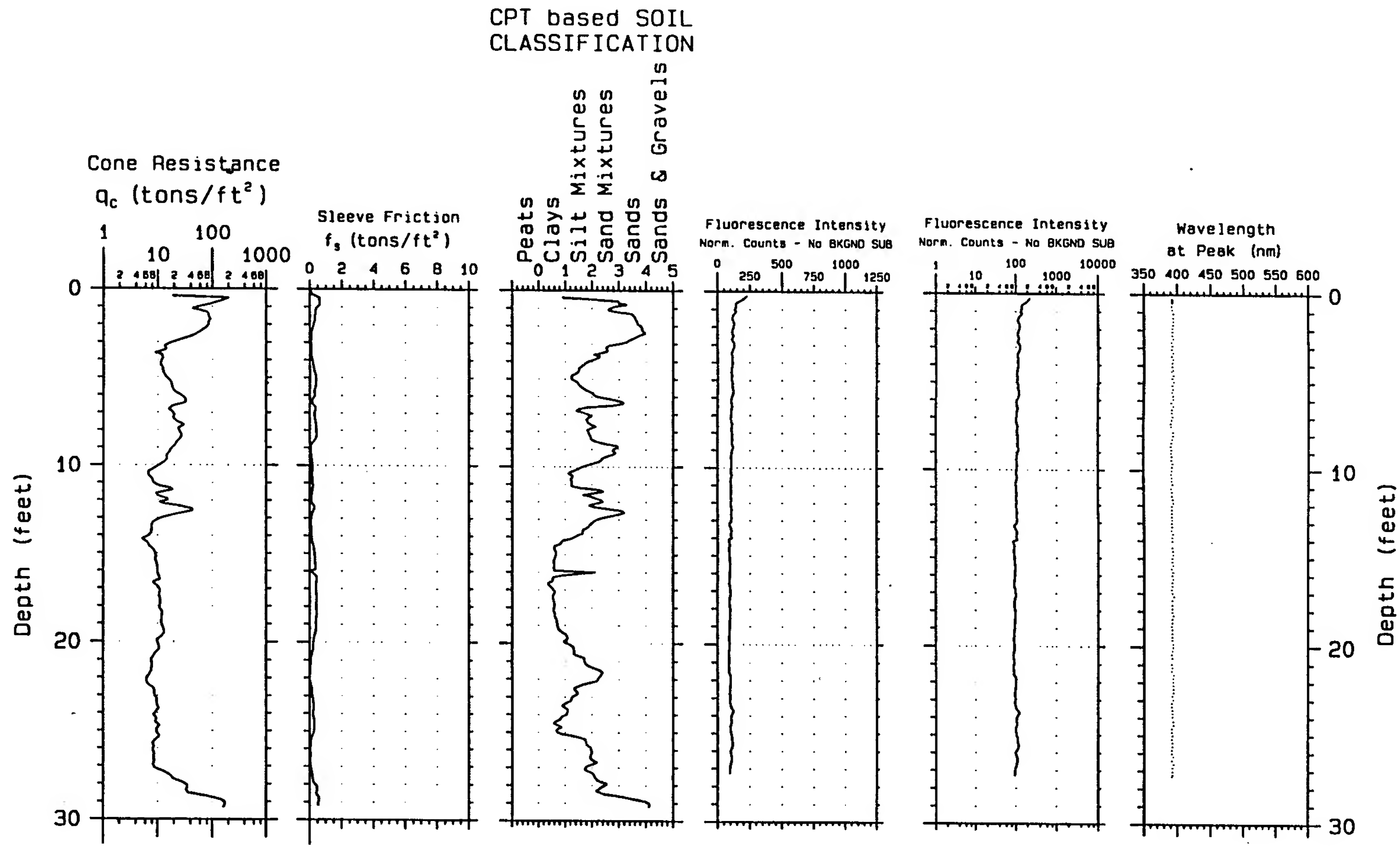
Project; Eaker AFB visit 4

Probe Depth; 33.07

Pre-Push Depth; 0

CPT; 11ESLF

Probing date; 03-27-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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Site Characterization and Analysis Penetrometer System

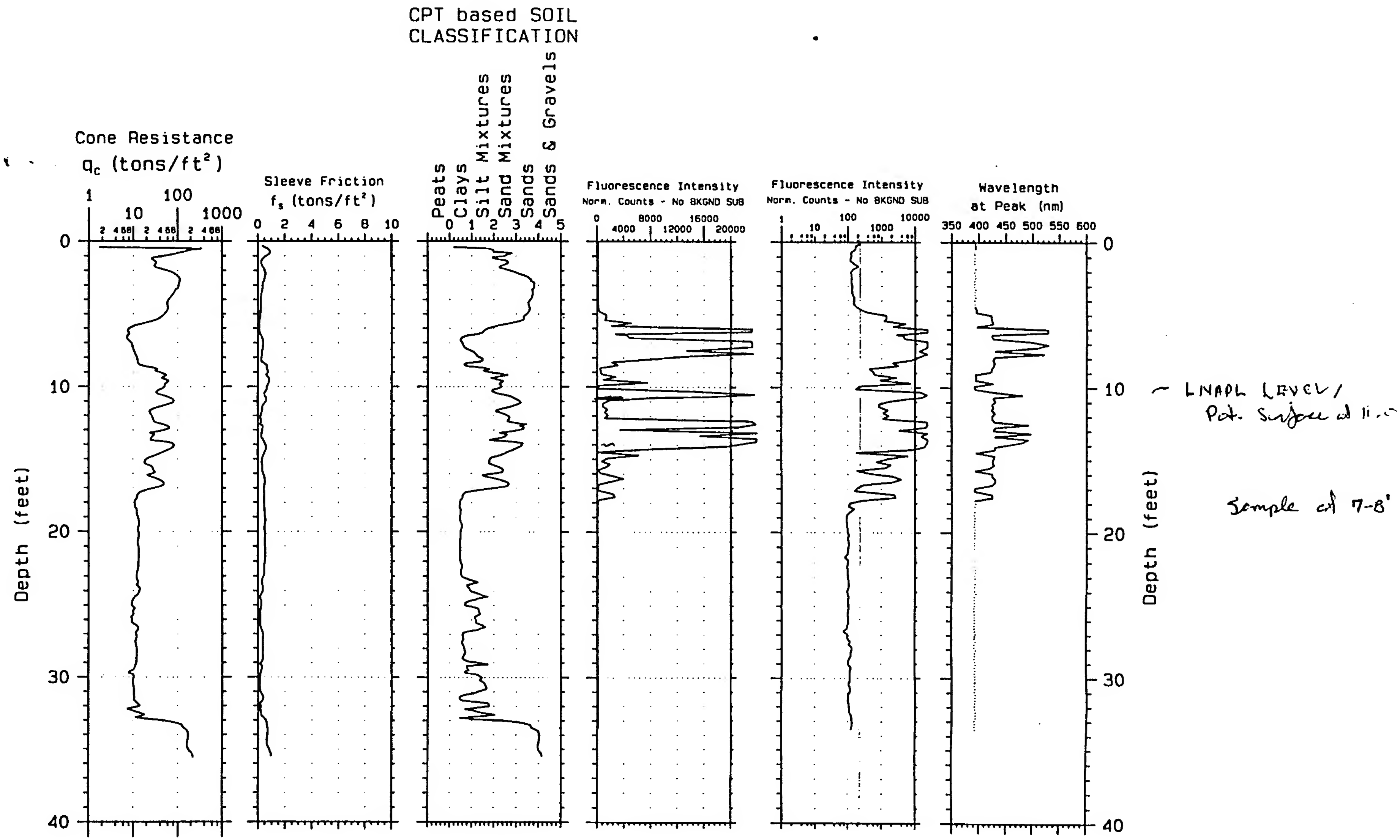
Project; Eaker AFB visit 4

Probe Depth; 29.44

Pre-Push Depth; 0

CPT; 12 F

Prob e; 03-27-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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SCAPS

Site Characterization and Analysis Penetrometer System

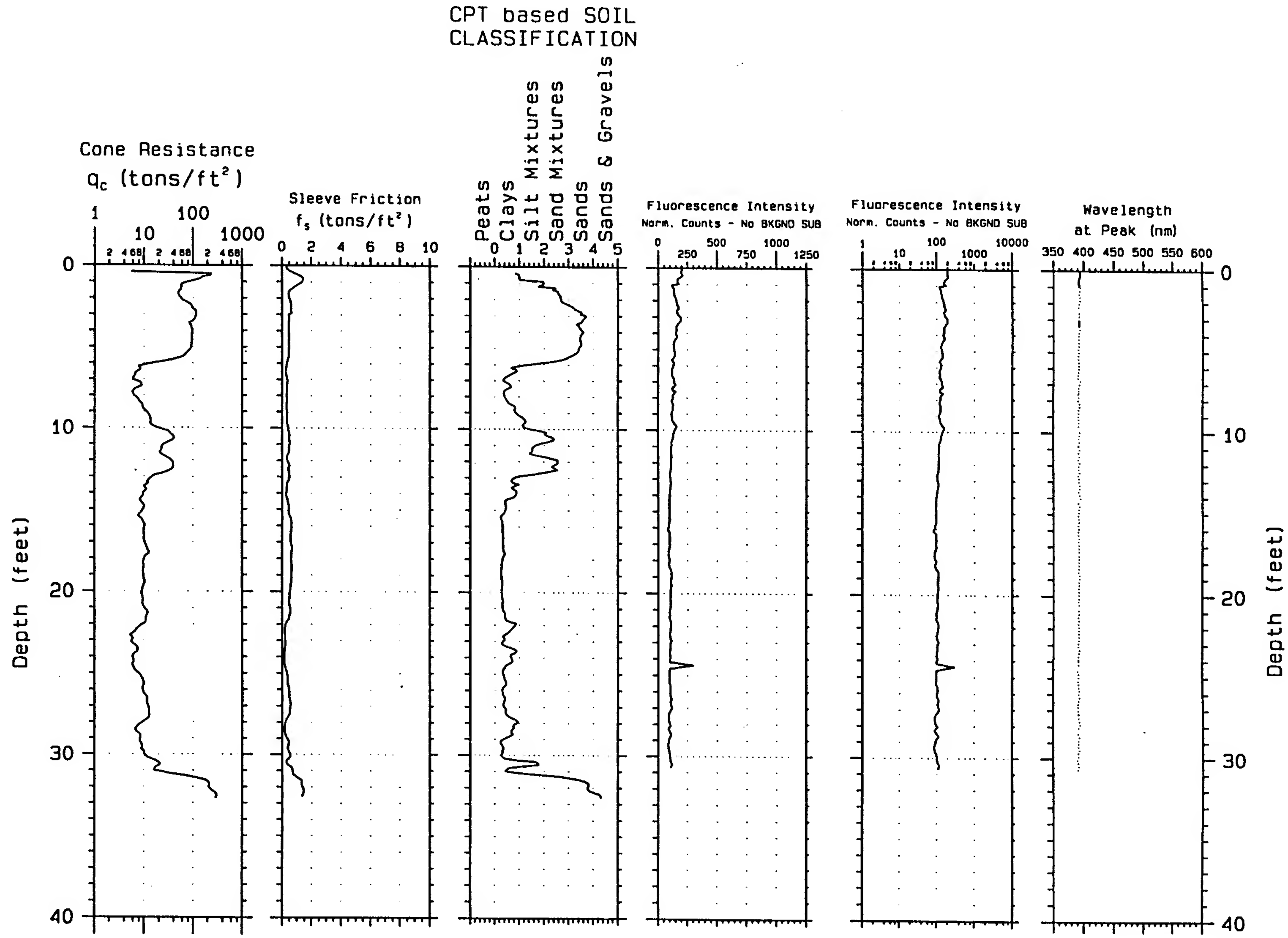
Project; Eaker AFB visit 4

Probe Depth; 35.79

Pre-Push Depth; 0

CPT; 13ESLF

Probing date; 03-27-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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SCAPS

Site Characterization and Analysis Penetrometer System

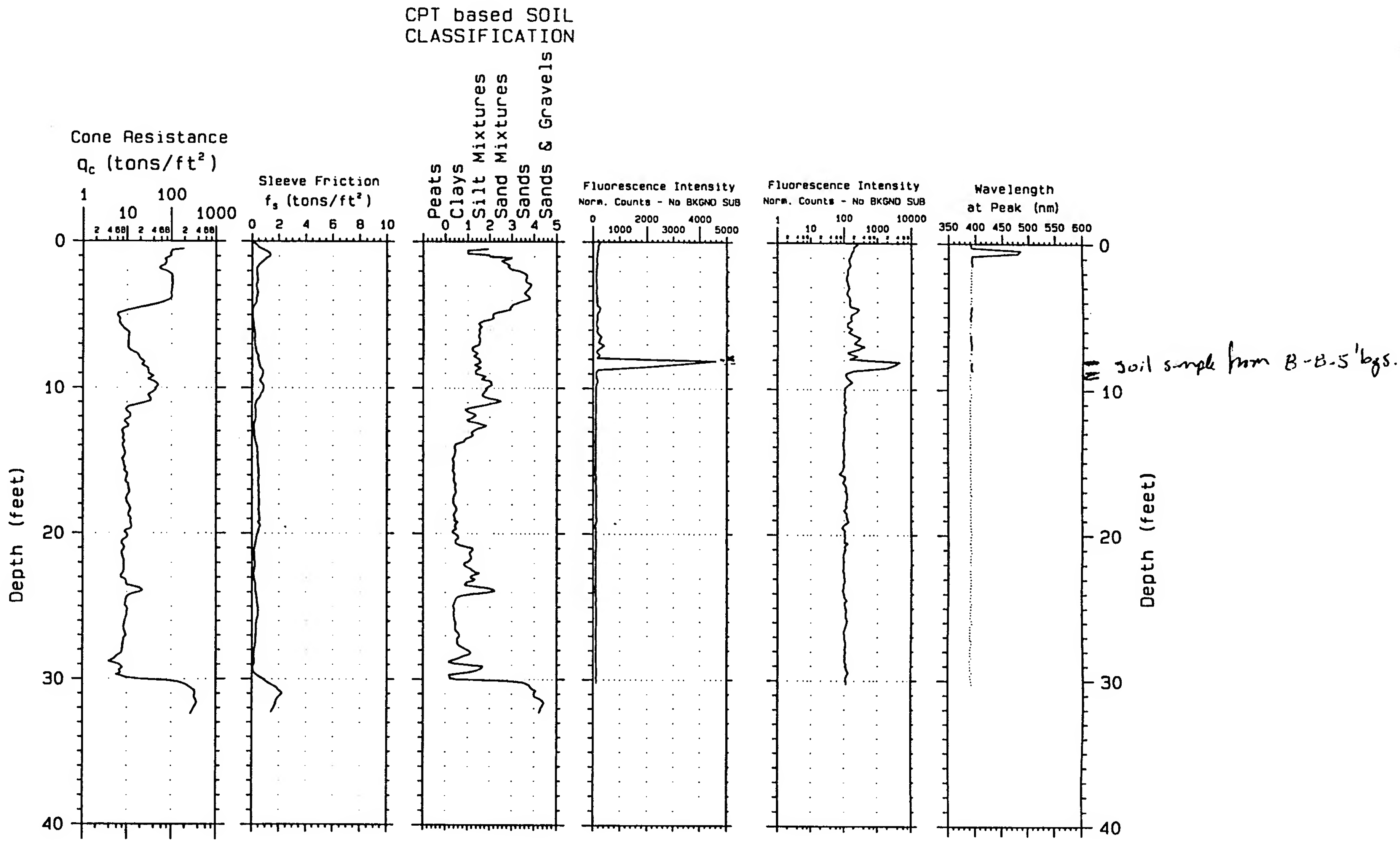
Project; Eaker AFB visit 4

Probe Depth; 32.83

Pre-Push Depth; 0

CPT; 14F[illegible] F

Prob[illegible]e; 03-27-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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Site Characterization and Analysis Penetrometer System

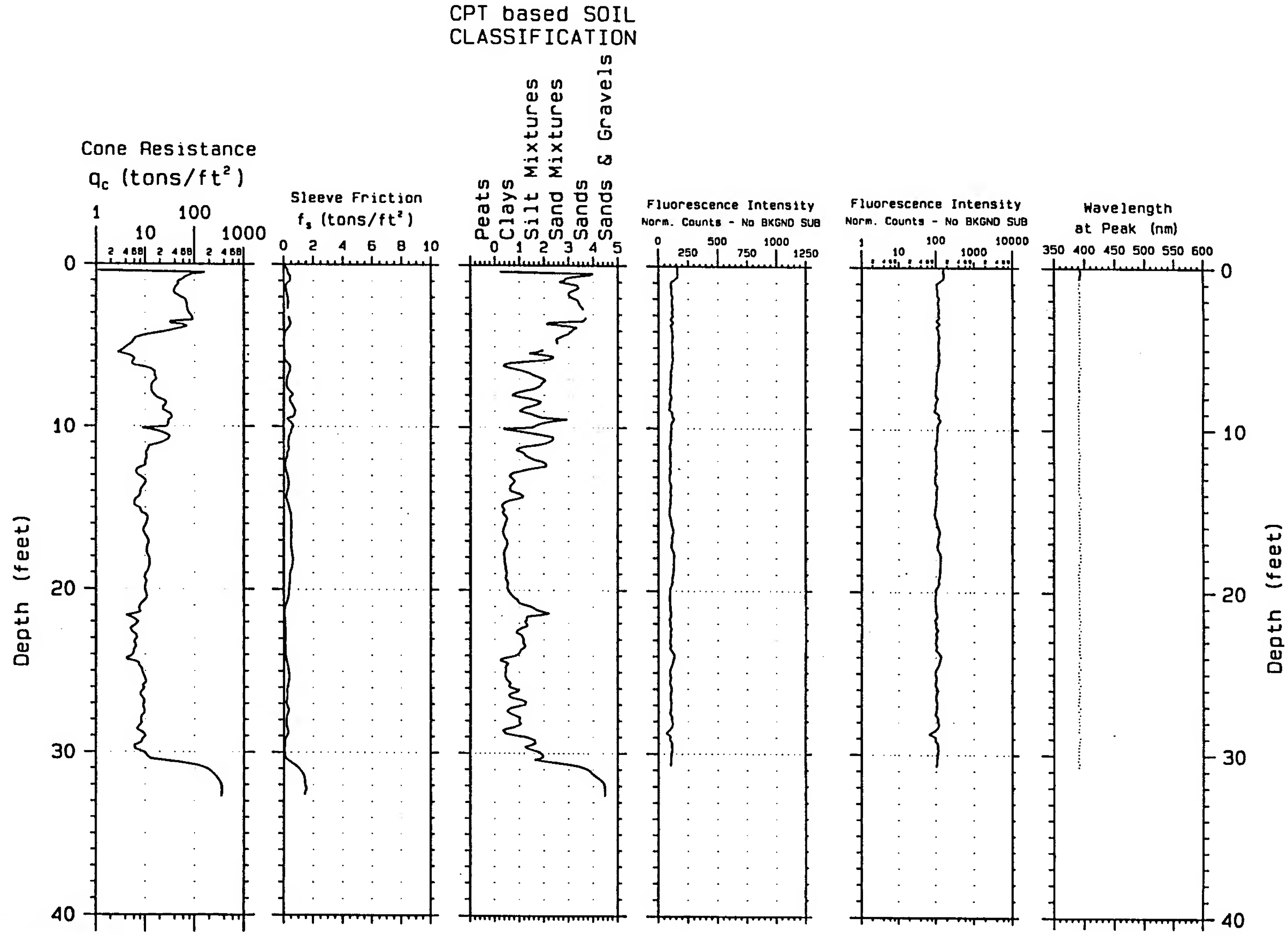
Project; Eaker AFB visit 4

Probe Depth; 32.55

Pre-Push Depth; 0

CPT; 15ESLF

Probing date; 03-27-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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Site Characterization and Analysis Penetrometer System

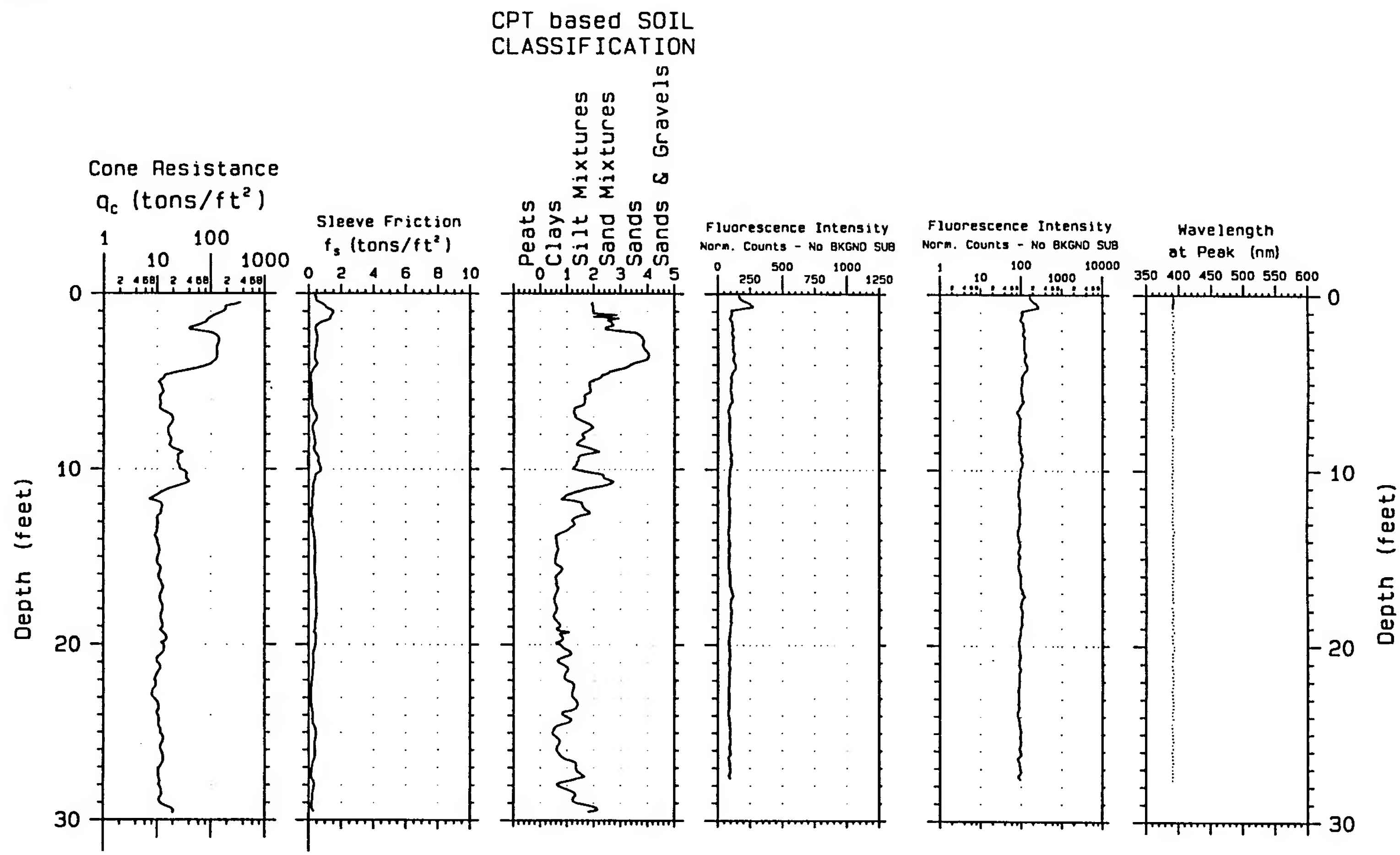
Project; Eaker AFB visit 4

Probe Depth; 32.87

Pre-Push Depth; 0

CPT; 16F

Prob e; 03-27-1996



Probing date; 03-27-1996

Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

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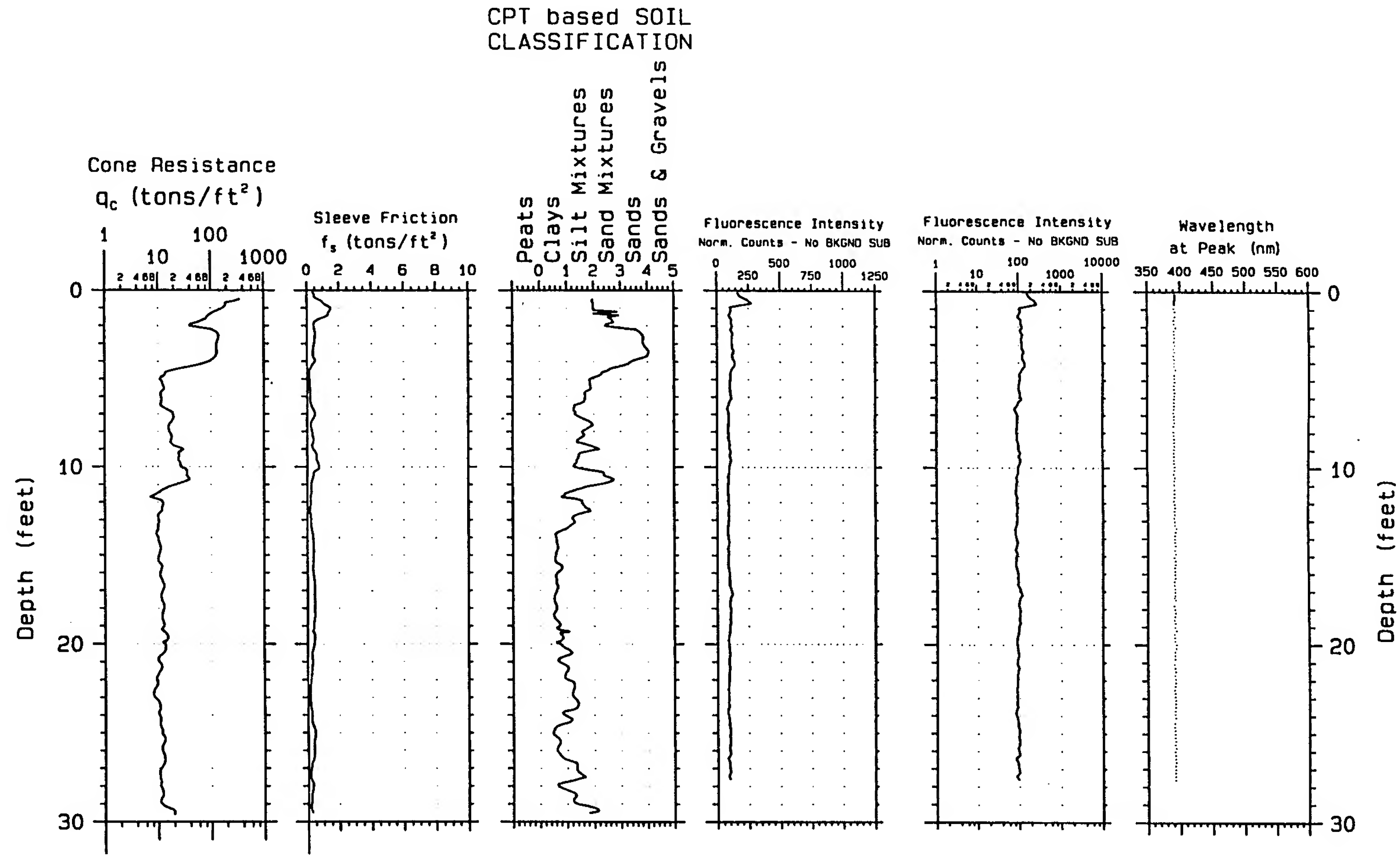
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB visit 4

Probe Depth; 29.80

Pre-Push Depth; 0

CPT; 17ESLF



Prob : 03-27-1996

Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK SCAPS

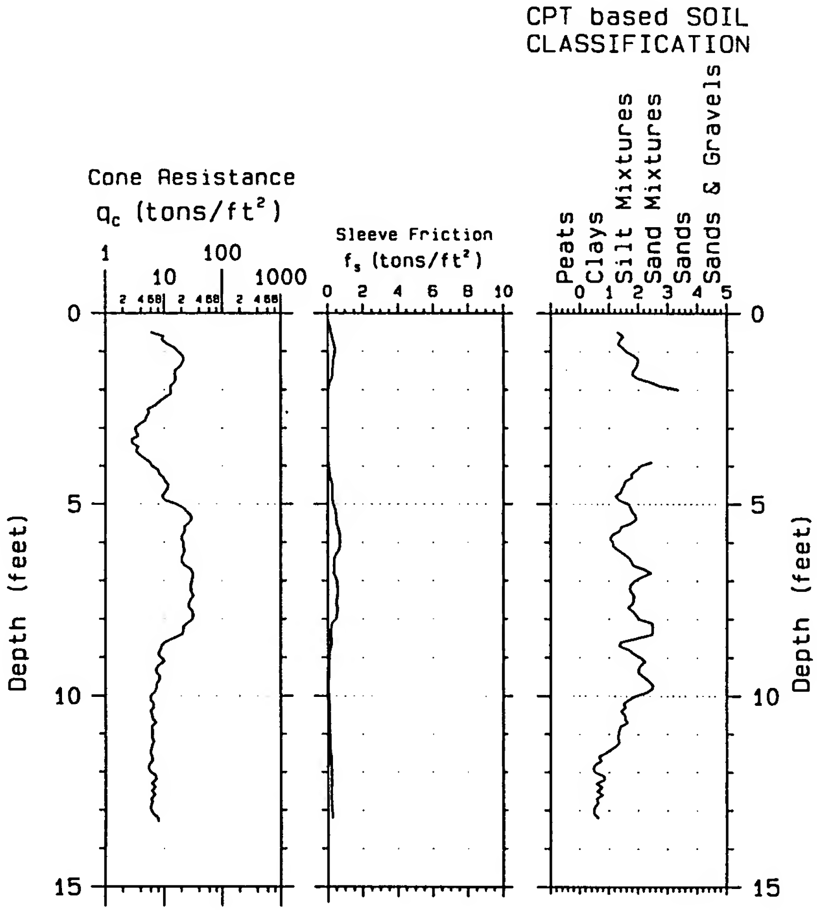
Site Characterization and Analysis Penetrometer System

Project; Eaker AFB visit 4

Probe Depth; 29.80

Pre-Push Depth; 0

CPT; 17 F



Probing date: 03-27-1996

U.S.Army
Engineer
District
Kansas City
Geotechnical Branch

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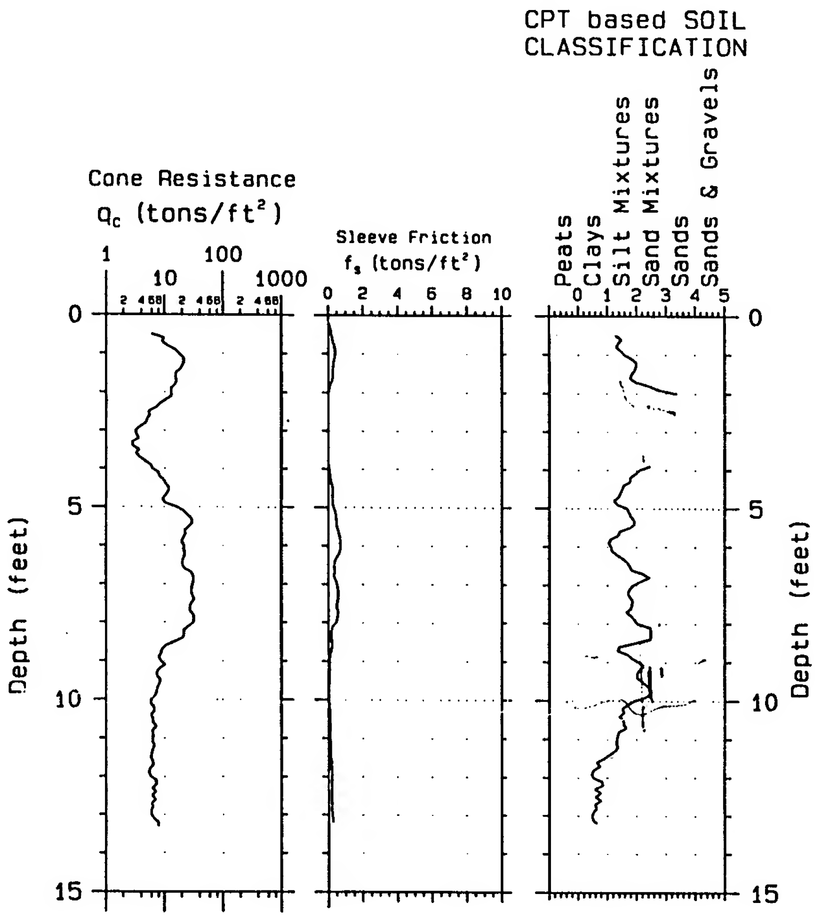
Site
Characterization
and Analysis
Penetrometer System

Project; Eaker AFB visit 4

Probe Depth; 13.49

Pre-Push Depth; 0

CPT; 18ESLF



Try 9-9.5
for soil collection

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Site Characterization and Analysis Penetrometer System

U.S.Army Engineer District Kansas City Geotechnical Branch

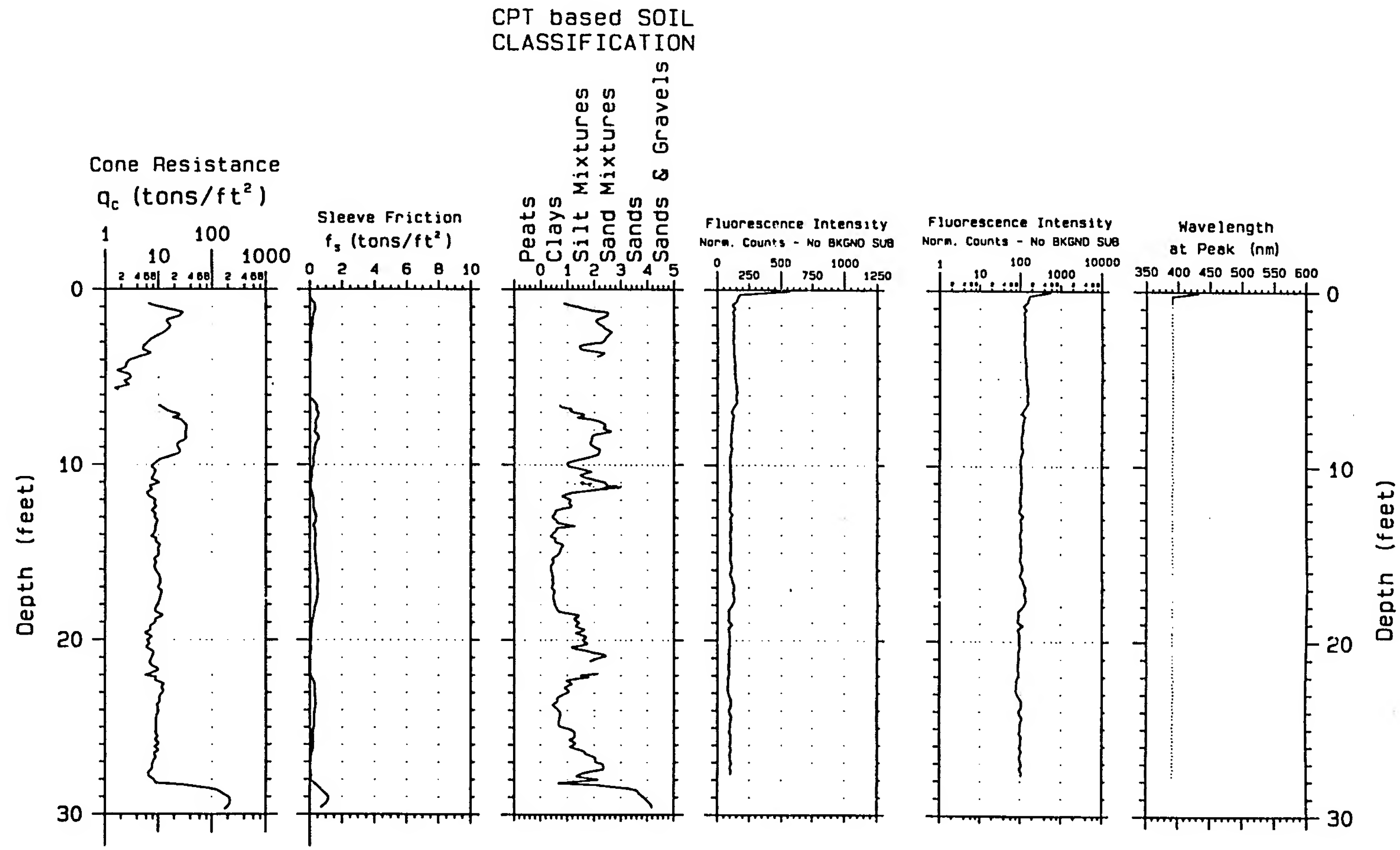
Project; Eaker AFB visit 4

Probe Depth; 13.49

Pre-Push Depth; 0

CPT; 18ESIF

Probe Date; 03-27-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK

SCAPS

Site Characterization and Analysis Penetrometer System

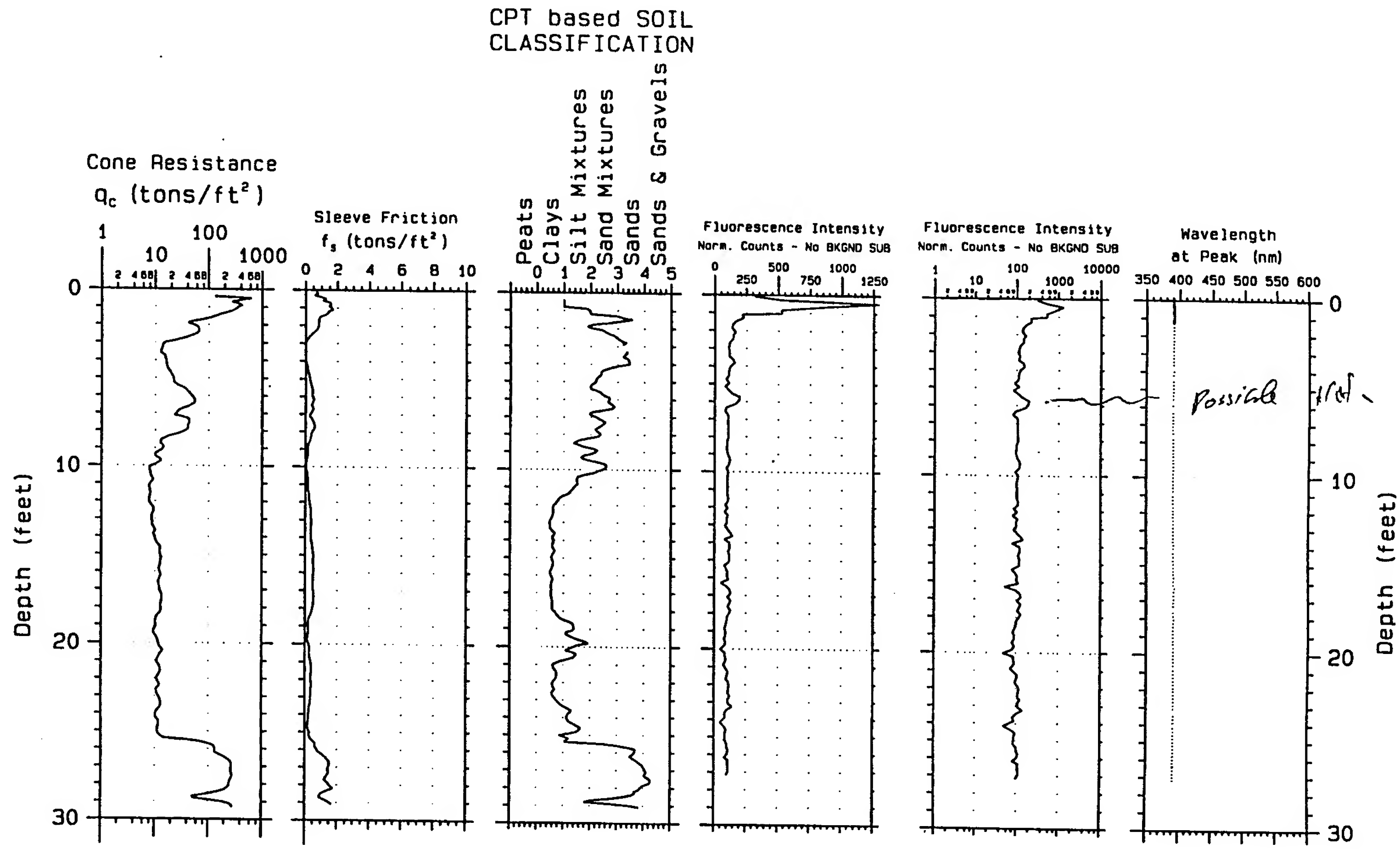
Project; Eaker AFB visit 4

Probe Depth; 29.89

Pre-Push Depth; 0

CPT; 19ESLF

Probing date; 03-27-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK

SCAPS

Site Characterization and Analysis Penetrometer System

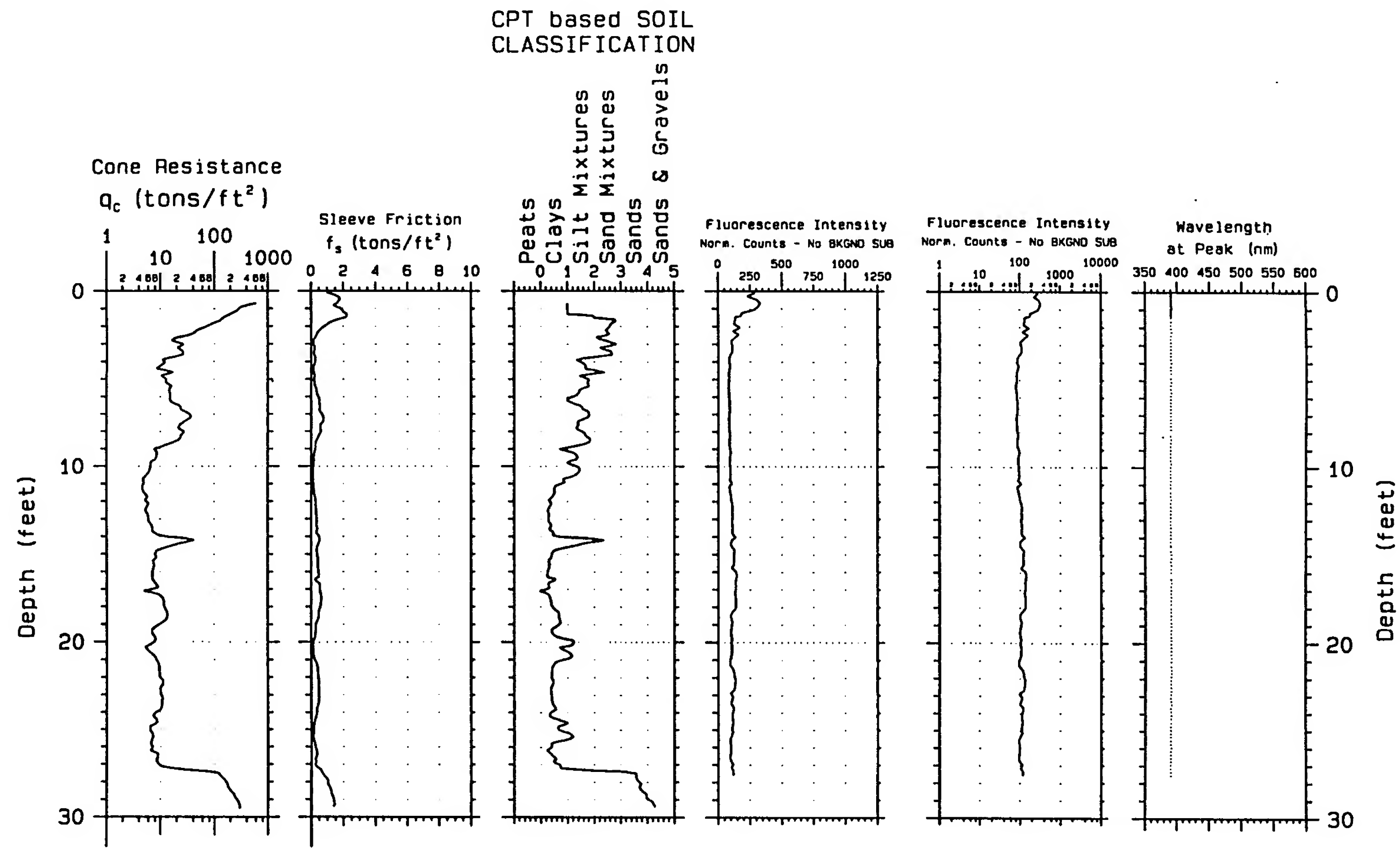
Project; Eaker AFB visit 4

Probe Depth; 29.40

Pre-Push Depth; 0

CPT; 20

Prob te: 03-28-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK

SCAPS

Site Characterization and Analysis Penetrometer System

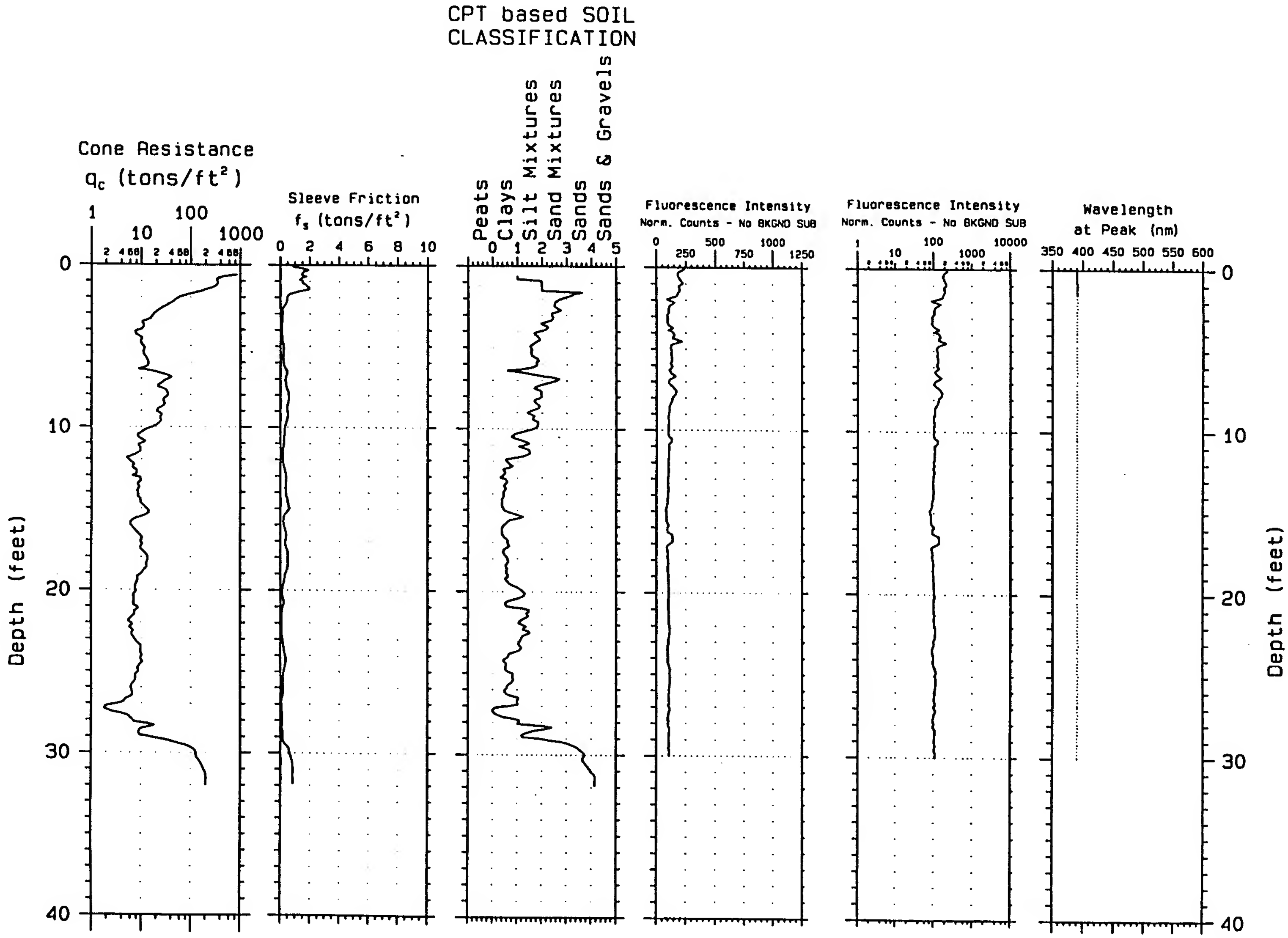
Project; Eaker AFB visit 4

Probe Depth; 29.70

Pre-Push Depth; 0

CPT; 21ESLF

Probing date; 03-28-1996



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK

SCAPS

Site Characterization and Analysis Penetrometer System

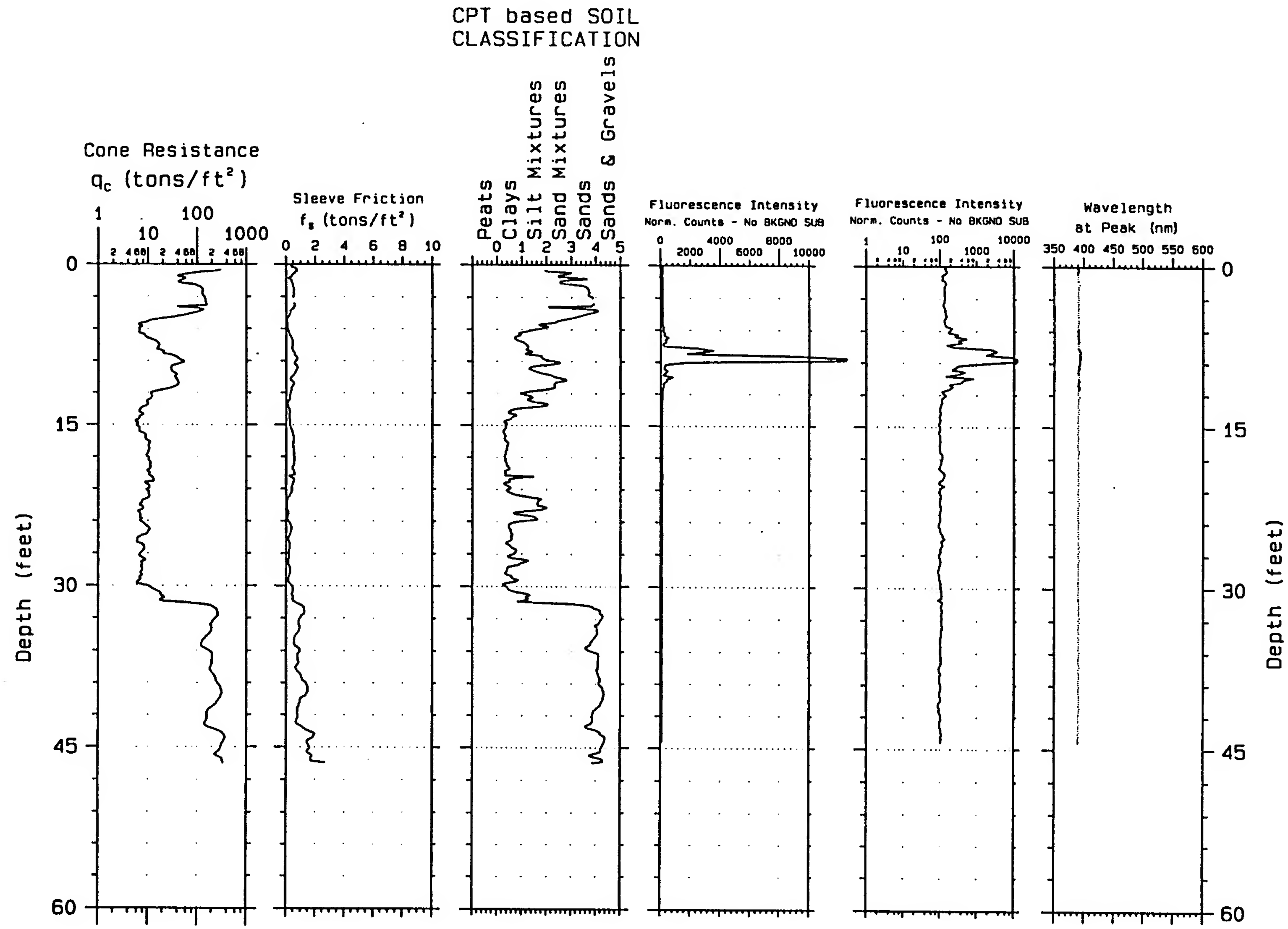
Project; Eaker AFB visit 4

Probe Depth; 32.16

Pre-Push Depth; 0

CPT; 22F SLF

Probi te; 03-28-1996



Probing date; 03-28-1996

Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

MRK SCAPS

Site Characterization and Analysis Penetrometer System

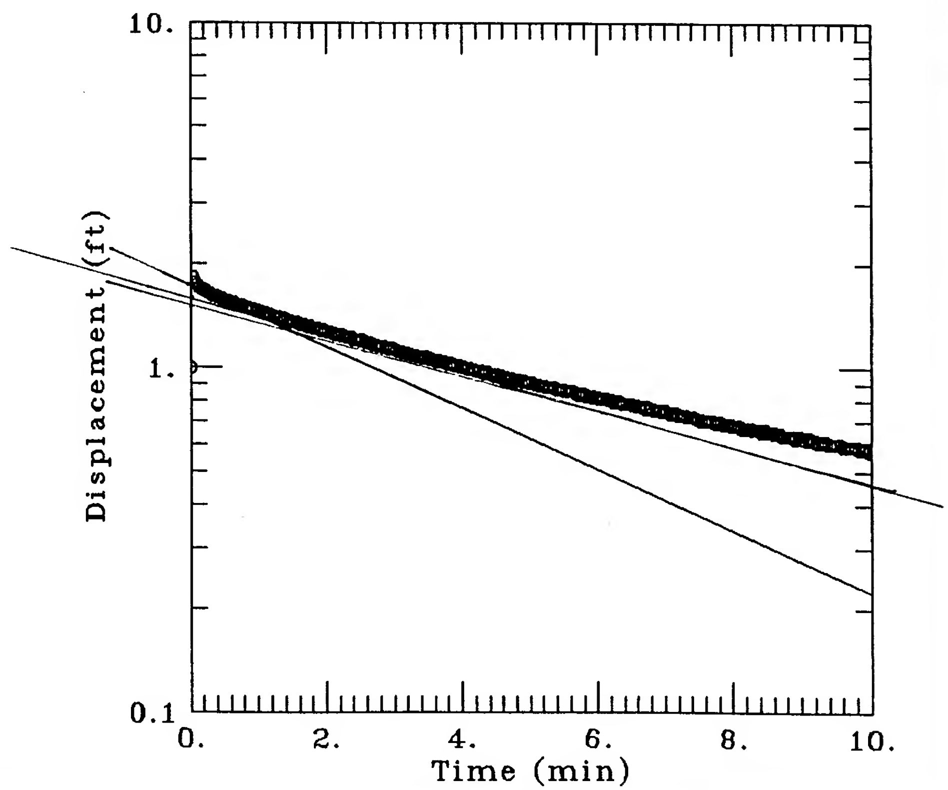
Project; Eaker AFB visit 4

Probe Depth; 46.61

Pre-Push Depth; 0

CPT; 23ESLF

MW1104-rising head test 1, BX Shoppette



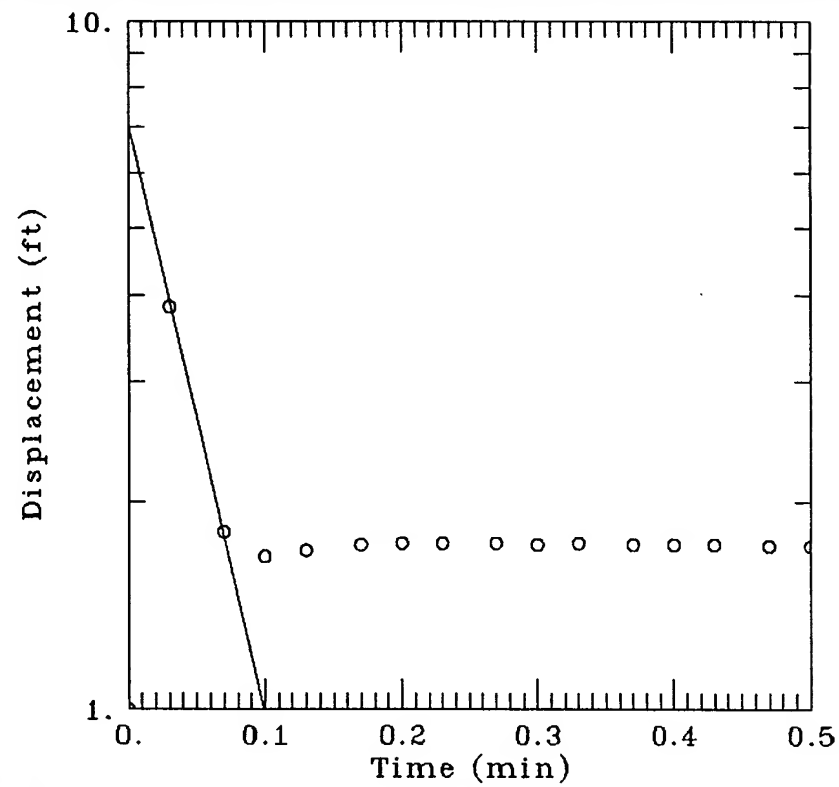
DATA SET:
c:\aq\bx1125r1.in
04/09/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 3.0403E-05 ft/min
y0 = 1.733 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.887 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1116-falling head test 1, BX Shoppette



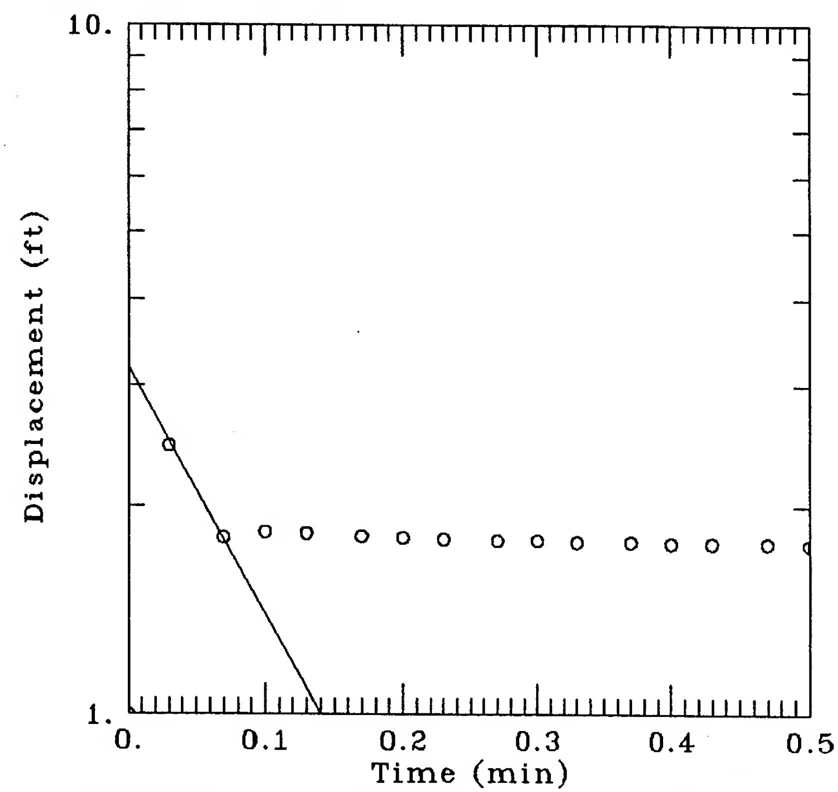
DATA SET:
c:\aq\mw1116f1.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.004403 ft/min
y0 = 7.037 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1116-rising head test 1, BX Shoppette



DATA SET:
c:\aq\mw1116r1.in
04/05/96

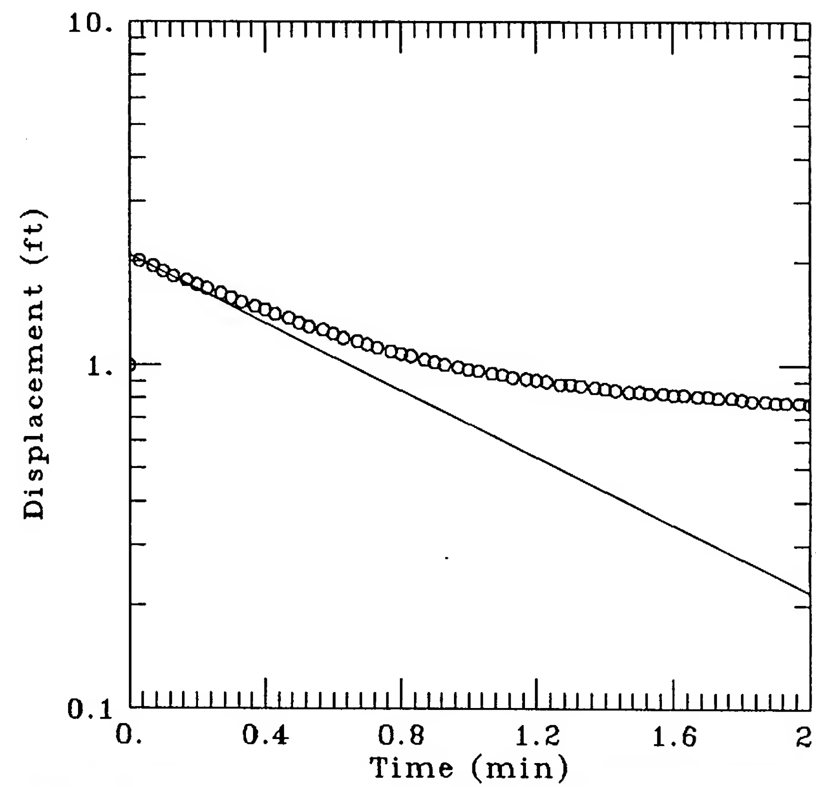
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.001849 ft/min
y0 = 3.178 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1119-rising head test 1, BX Shoppette



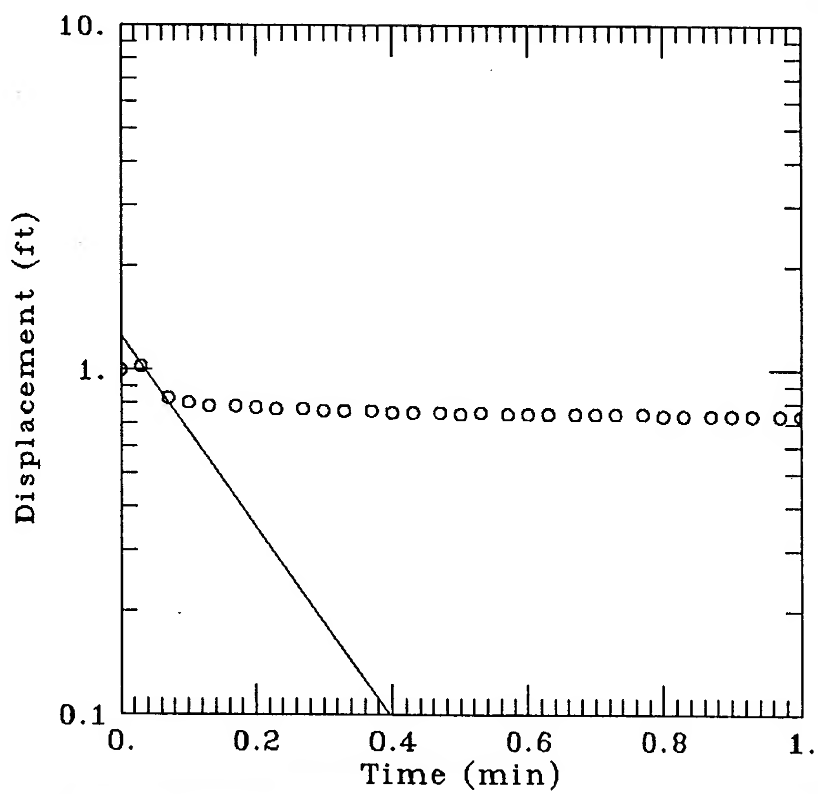
DATA SET:
c:\aq\mw1119r1.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.0002534 ft/min
y0 = 2.089 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1119–falling head test 1, BX Shoppette



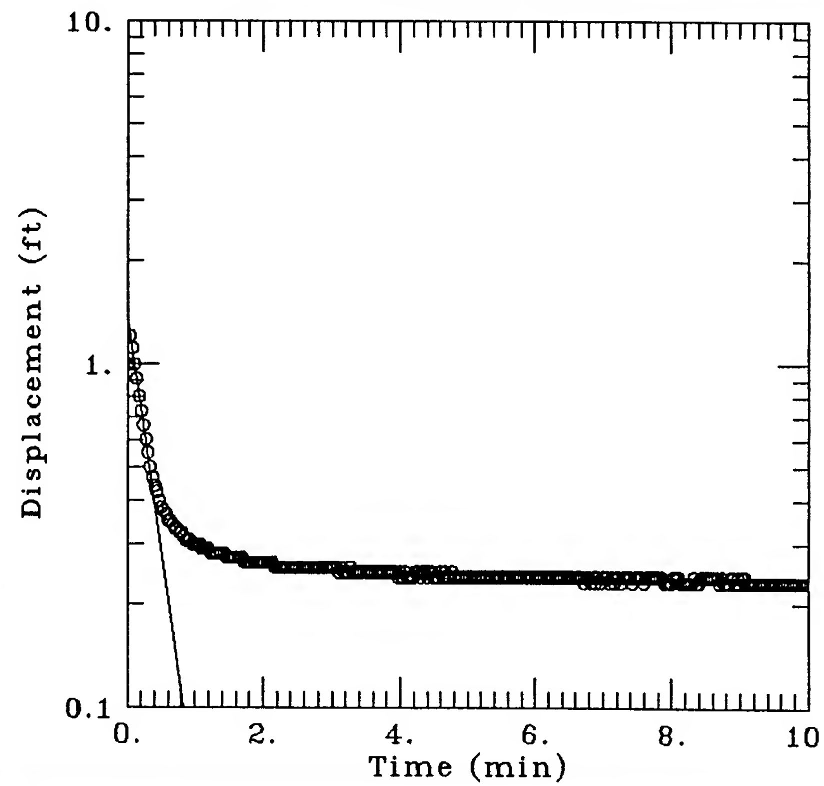
DATA SET:
c:\aq\mw1119f1.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.001425 ft/min
y0 = 1.253 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1121-rising head test 1, BX Shoppette



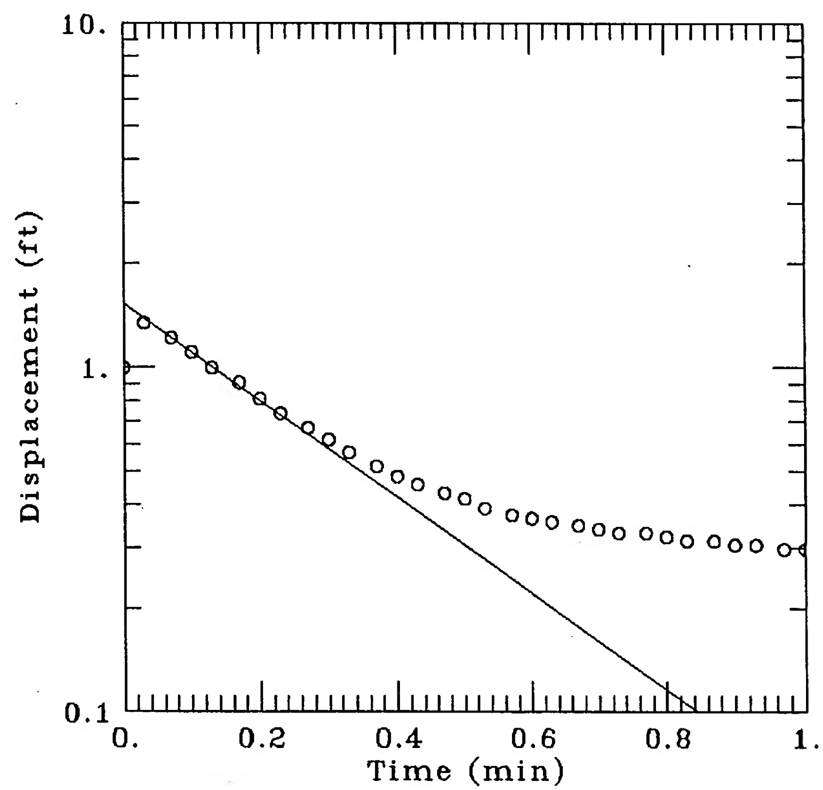
DATA SET:
c:\aq\bx1125r1.in
04/09/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.0004717 ft/min
y0 = 1.358 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.887 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1121-rising head test 2, BX Shoppette



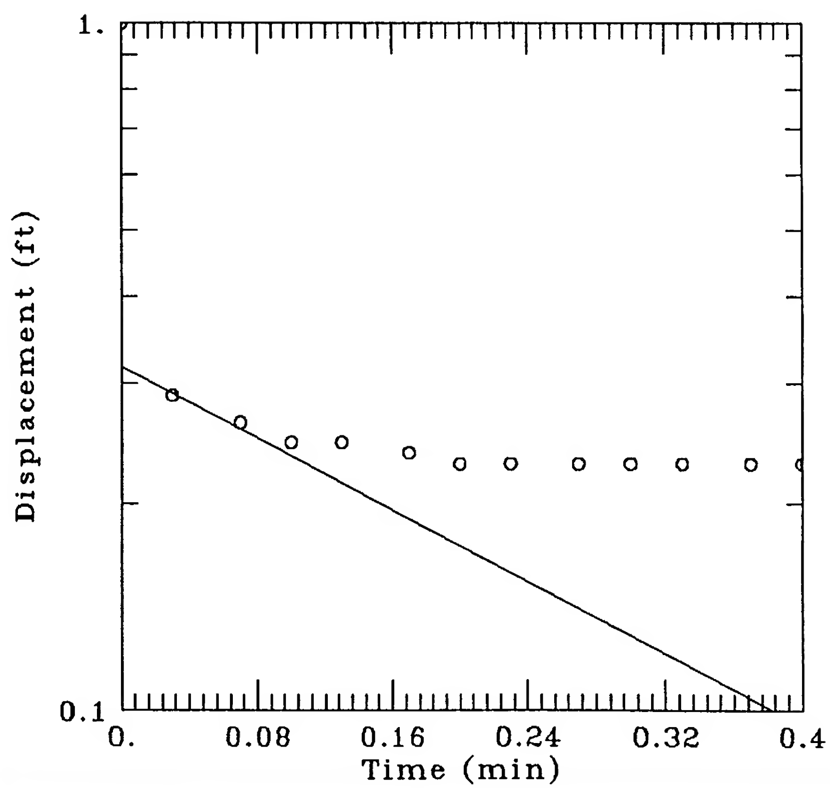
DATA SET:
c:\aq\mw1121r2.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.0007223 ft/min
y0 = 1.528 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1121-falling head test 1, BX Shoppette



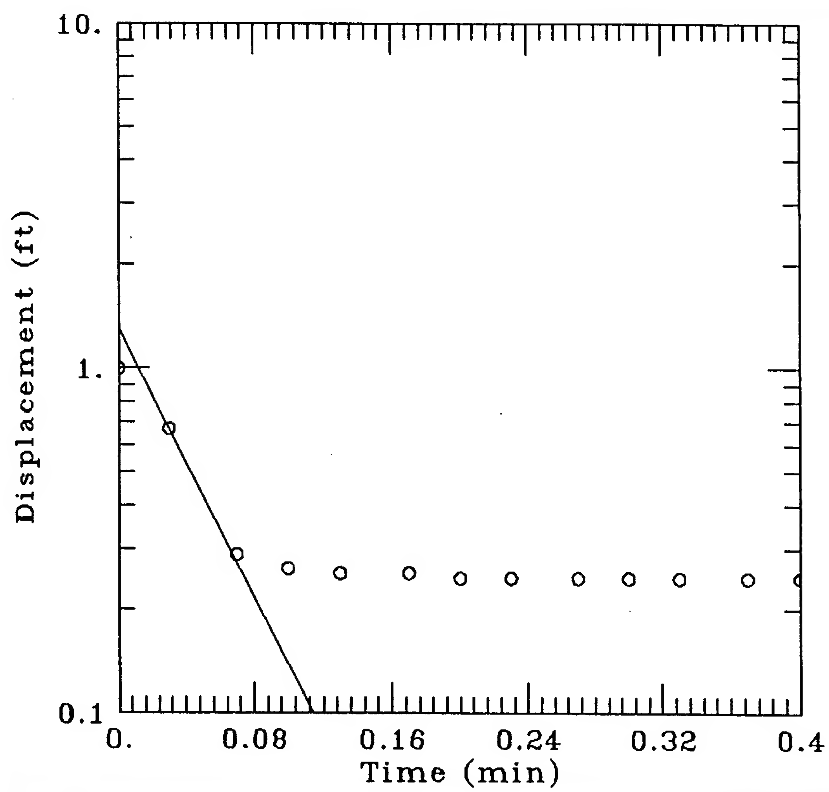
DATA SET:
c:\aq\mw1121f1.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.0006753 ft/min
y0 = 0.3173 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1121-falling head test 2, BX Shoppette



DATA SET:
c:\aq\mw1121f2.in
04/05/96

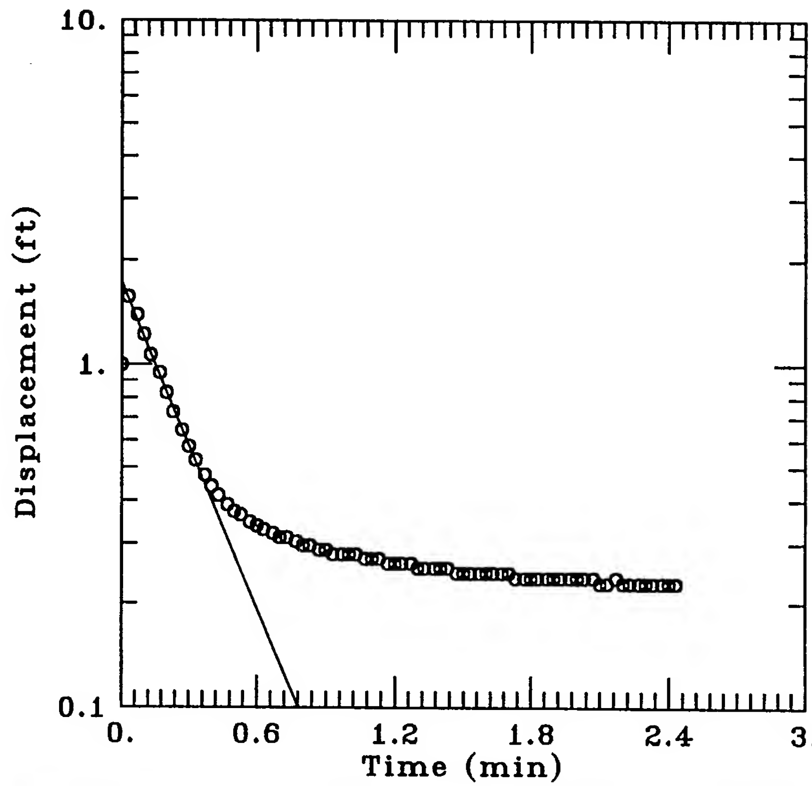
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.005009 ft/min
y0 = 1.302 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1123-rising head test 1, BX Shoppette



DATA SET:
c:\aq\bx1123r1.in
04/04/96

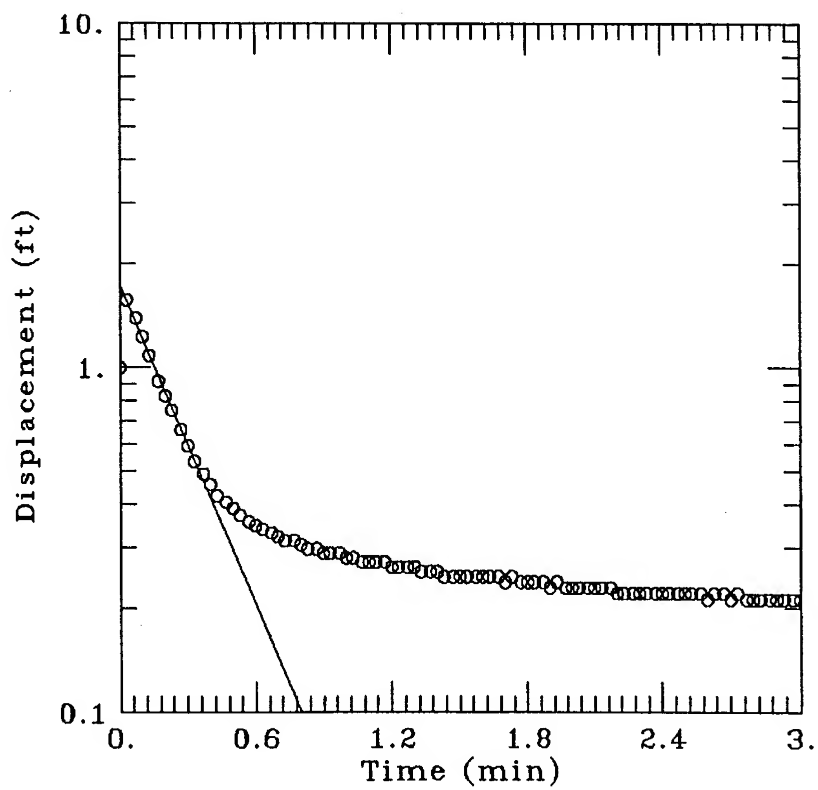
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.0008156 ft/min
y0 = 1.729 ft

TEST DATA
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1123-rising head test 2, BX Shoppette



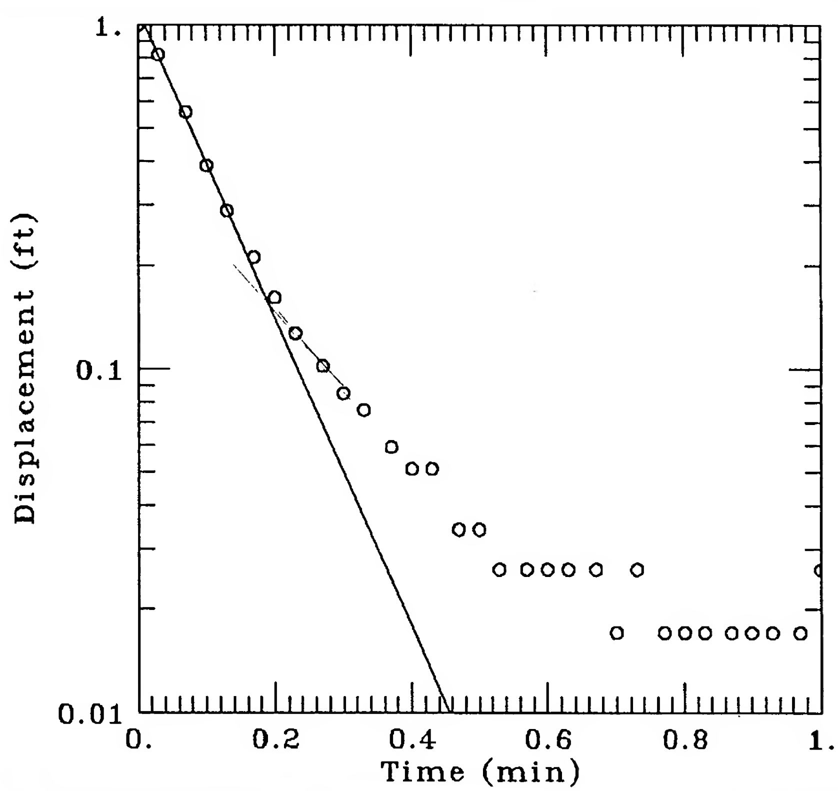
DATA SET:
C:\aq\bx1123r2.in
04/04/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.0007957 ft/min
y0 = 1.723 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW-1124 rising head test 2, BX Shoppette



DATA SET:
c:\aq\bx1124r2.in
04/09/96

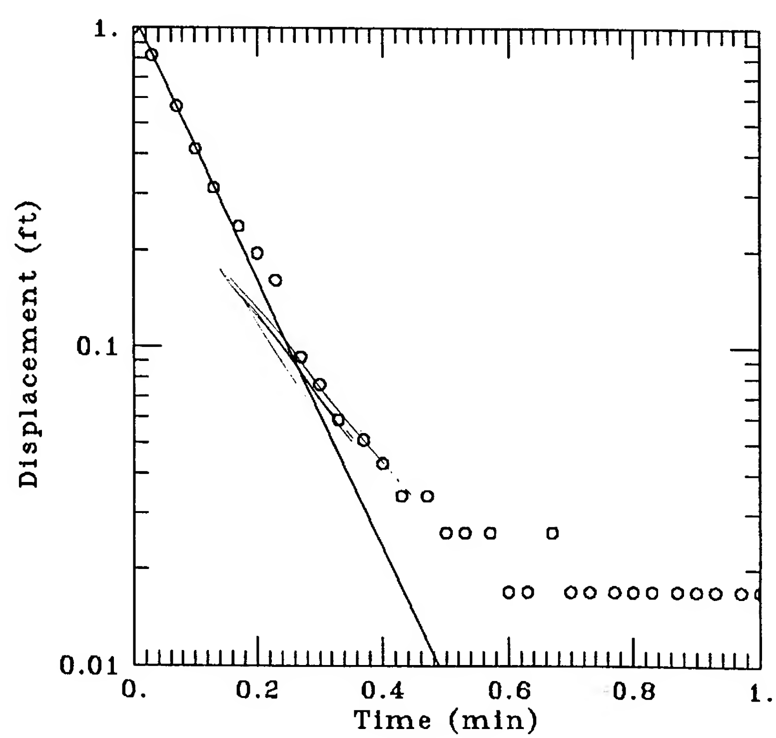
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.004974 ft/min
y0 = 1.113 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.667 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1124-rising head test 3, BX Shoppette



DATA SET:
L:\45015\slugtest\raw_data\bx1124r3.in
04/09/96

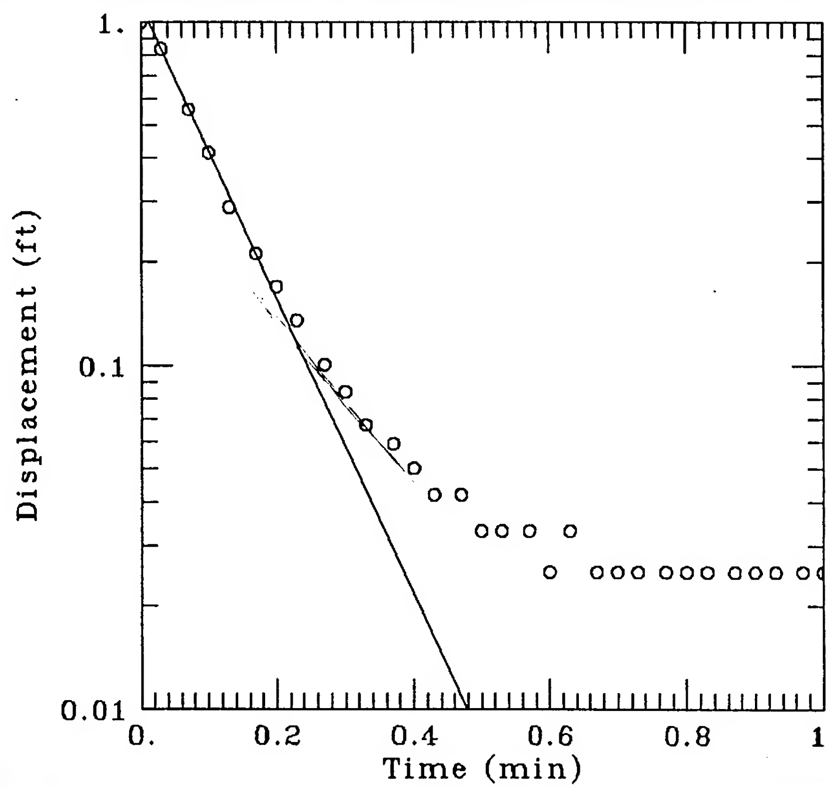
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.001428 ft/min
y0 = 1.1 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.887 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1124-falling head test 1, BX Shoppette



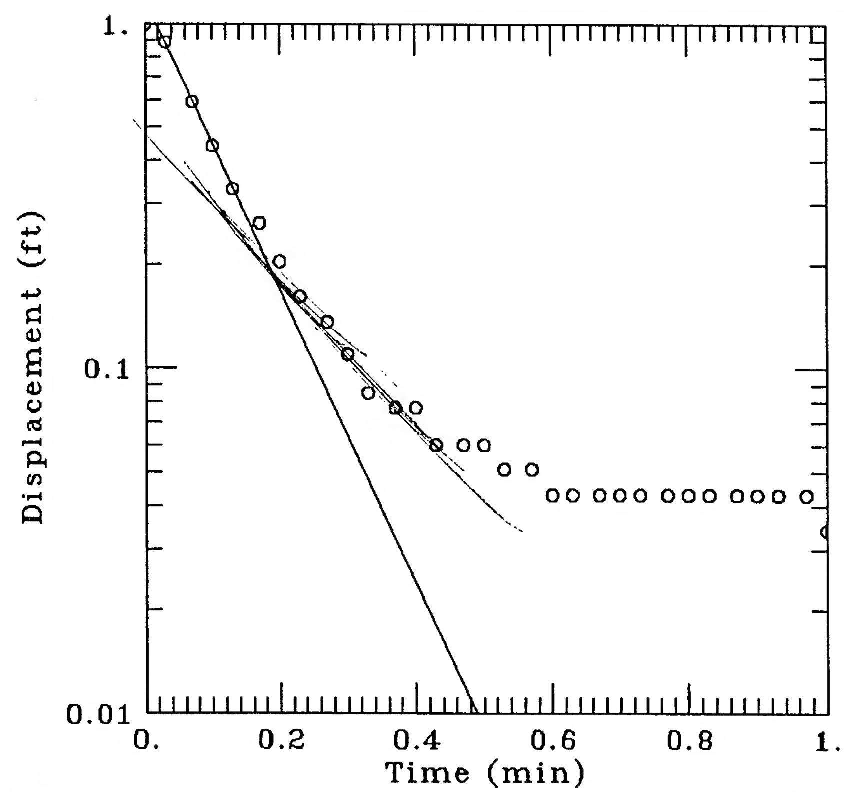
DATA SET:
c:\aq\bx1124f1.in
04/04/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002206 ft/min
y0 = 1.121 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1124-falling head test 2, BX Shoppette



DATA SET:
c:\aq\bx1124f2.in
04/04/96

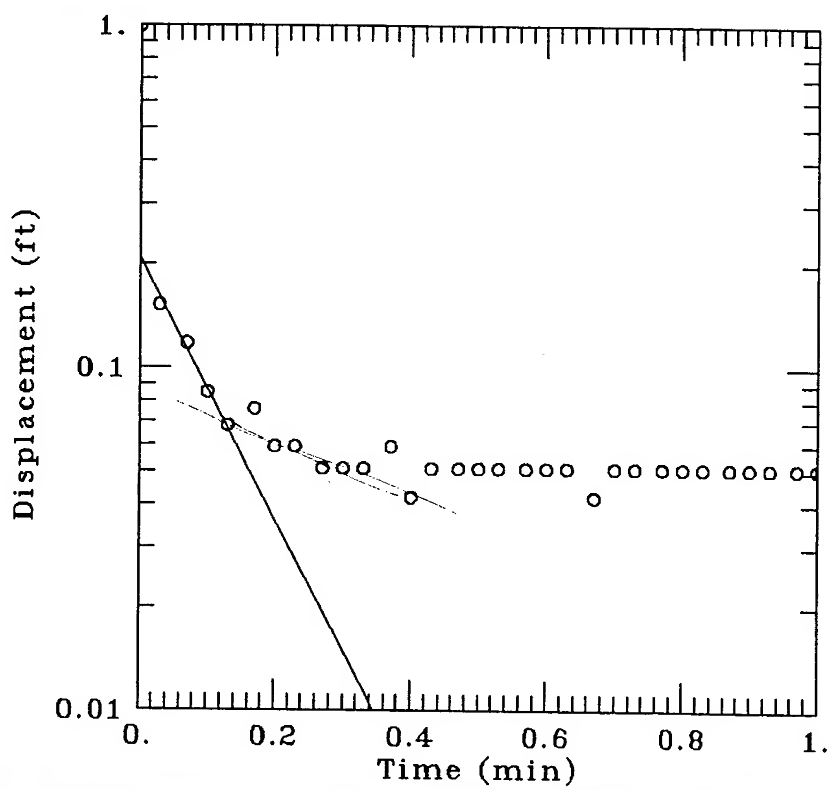
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002182 ft/min
y0 = 1.195 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1125-rising head test 1, BX Shoppette



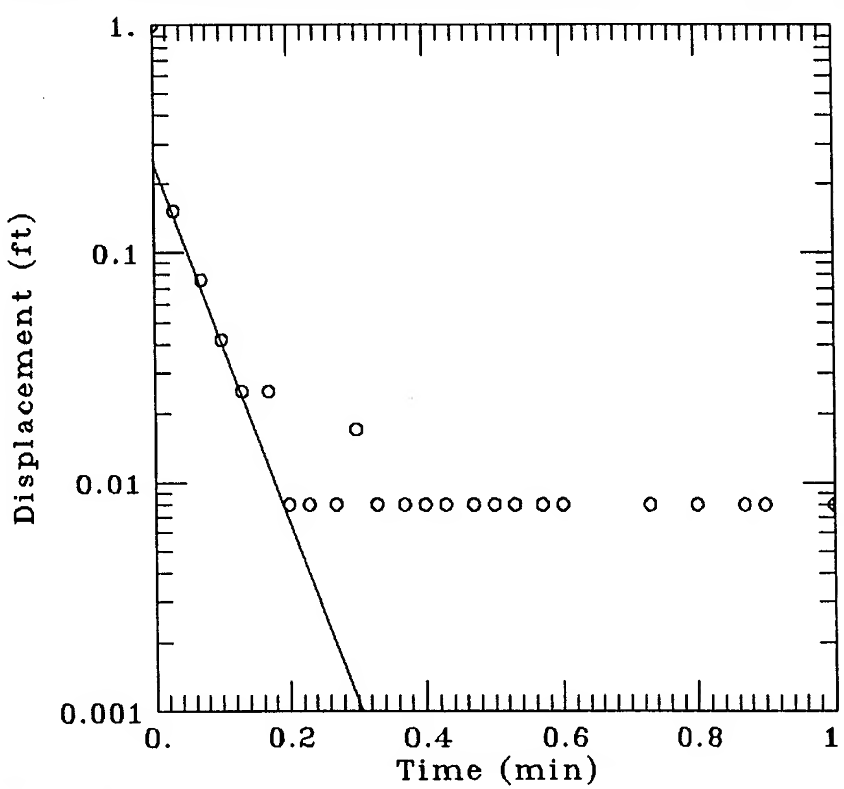
DATA SET:
c:\aq\bx1125r1.in
04/09/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.001302 ft/min
y0 = 0.2086 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.887 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1125-rising head test 2, BX Shoppette



DATA SET:
c:\aq\bx1125r1.in
04/09/96

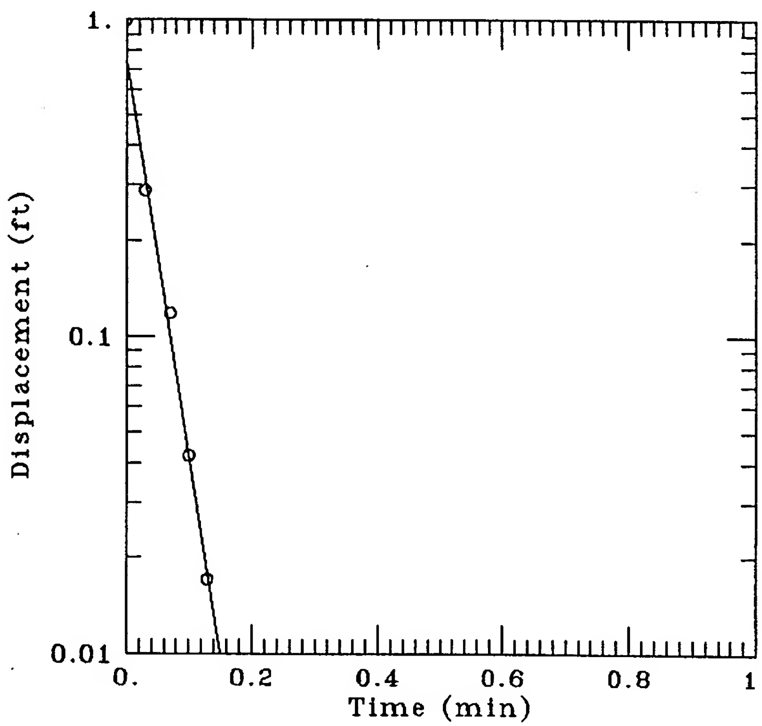
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002664 ft/min
y0 = 0.2434 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.887 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1125–falling head test 1, BX Shoppette



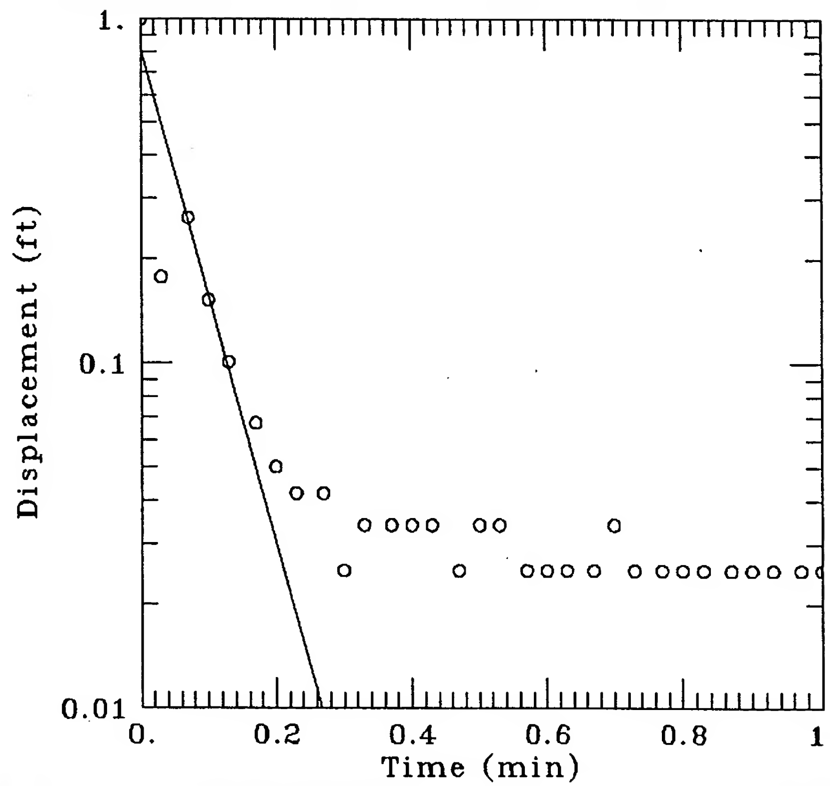
DATA SET:
L:\45015\slugtest\raw_data\bx1124r3.in
04/09/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.004247 ft/min
y0 = 0.7444 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.887 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1125-falling head test 2, BX Shoppette



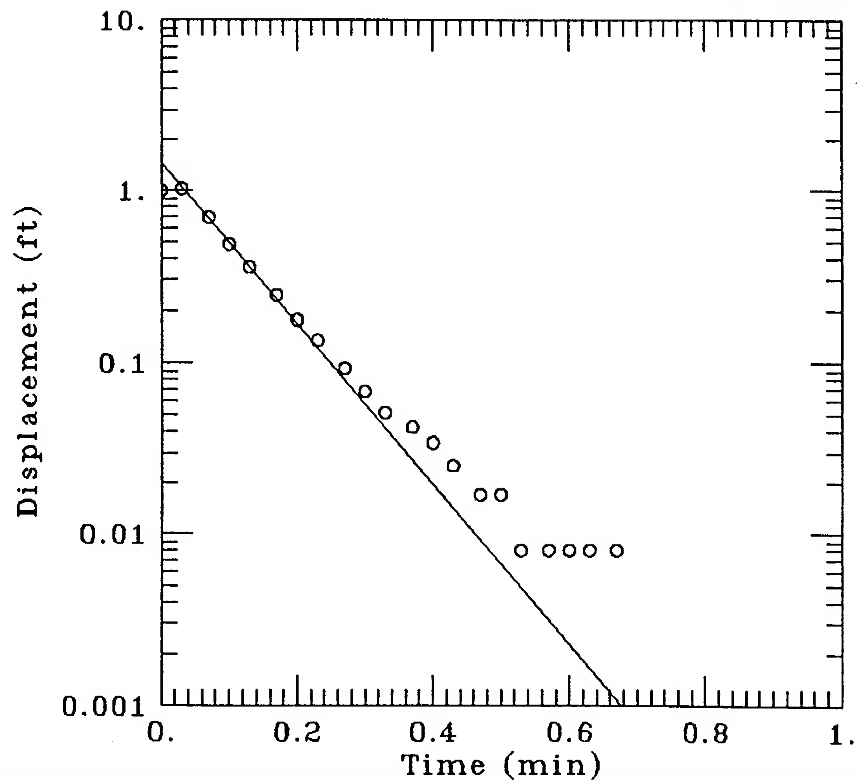
DATA SET:
c:\aq\bx1125f2.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.003666 ft/min
y0 = 0.8074 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1126-rising head test 1, BX Shoppette



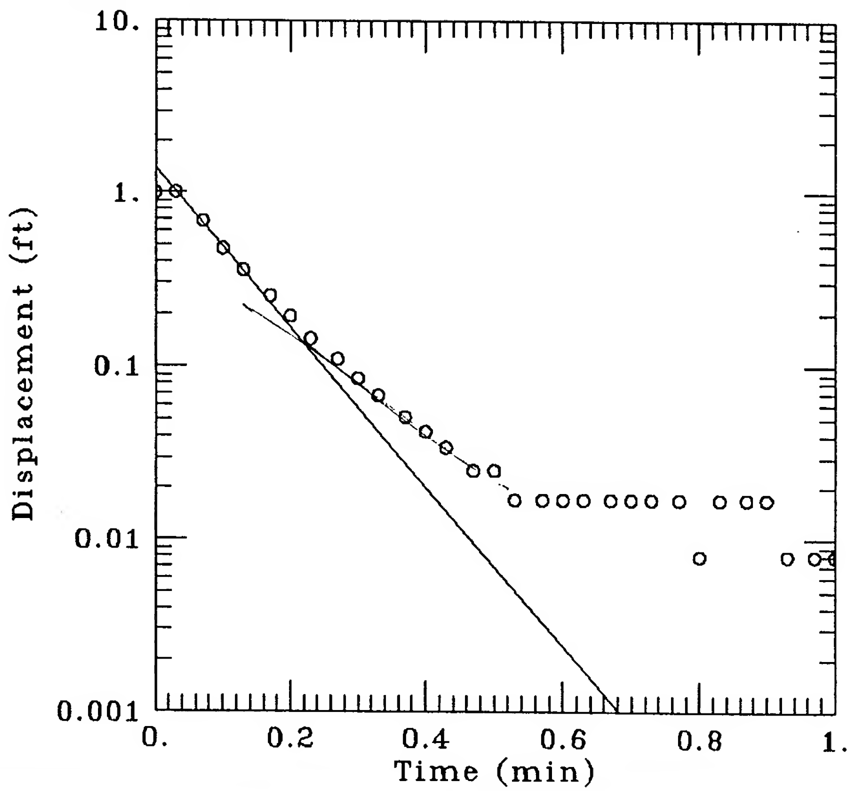
DATA SET:
c:\aq\mw1126r1.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002401 ft/min
y0 = 1.435 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1126-rising head test 2, BX Shoppette



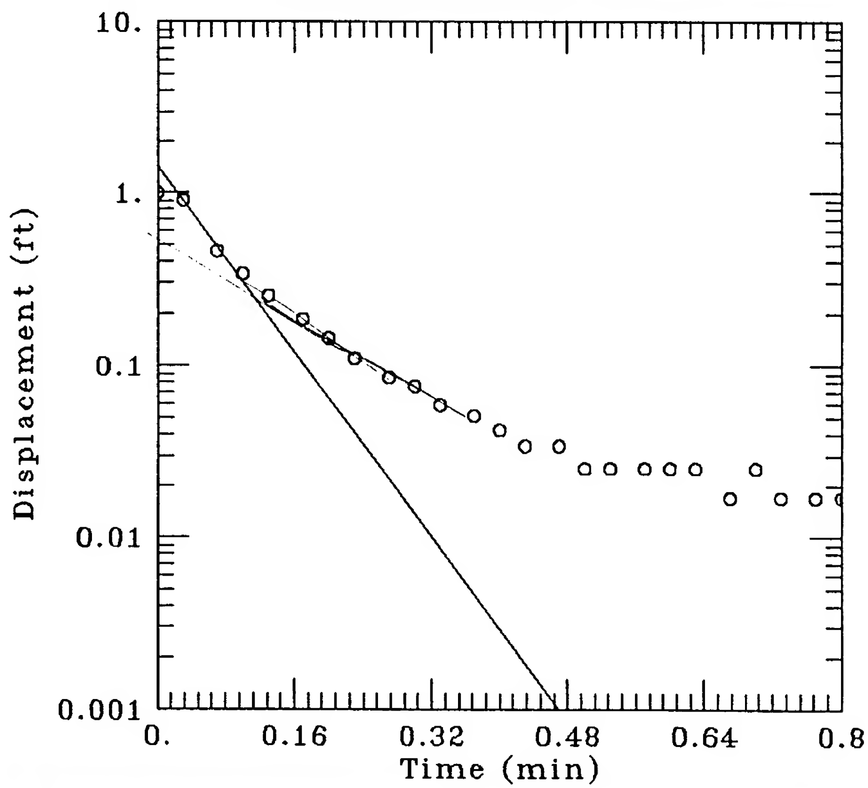
DATA SET:
c:\aq\mw1126r2.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002377 ft/min
y0 = 1.403 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1126-falling head test 1, BX Shoppette



DATA SET:
c:\aq\mw1126f1.in
04/05/96

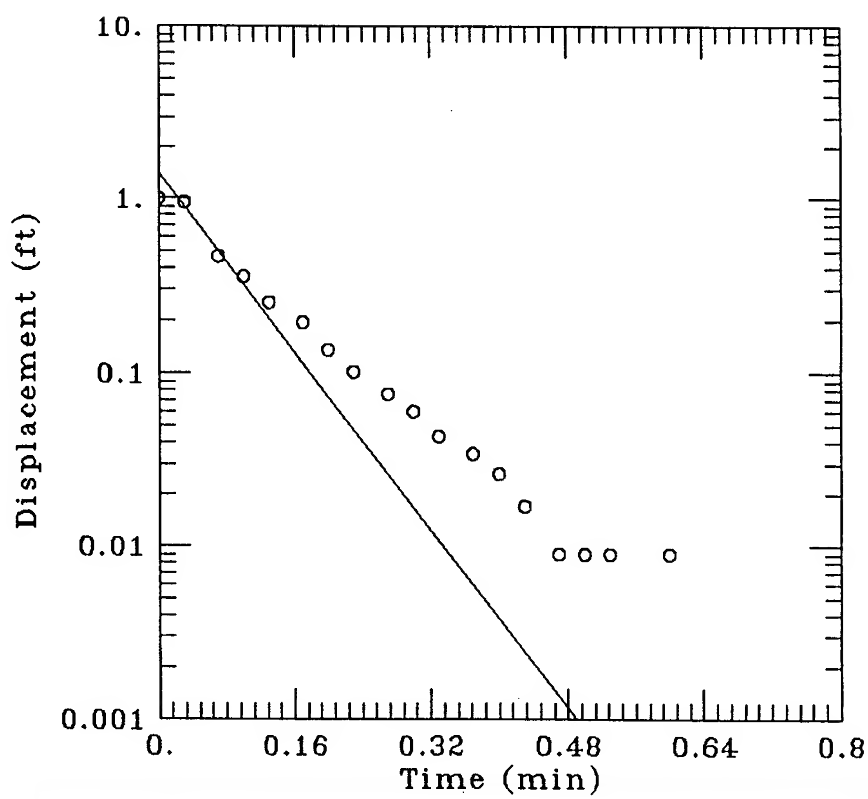
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.003458 ft/min
y0 = 1.413 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1126-falling head test 2, BX Shoppette



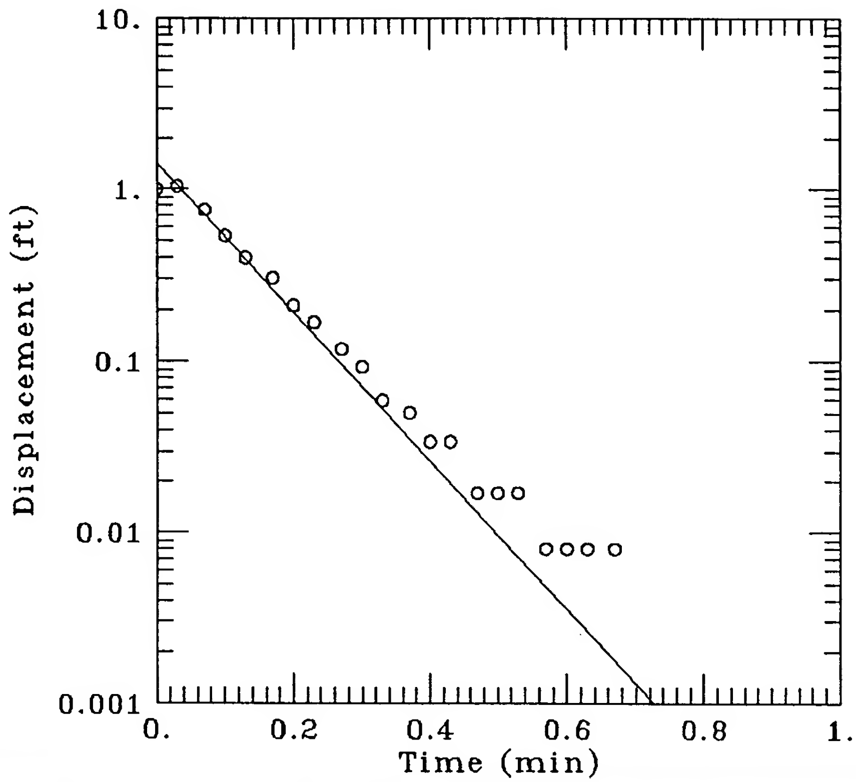
DATA SET:
c:\aq\mw1126f2.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.003311 ft/min
y0 = 1.403 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1127-rising head test 1, BX Shoppette



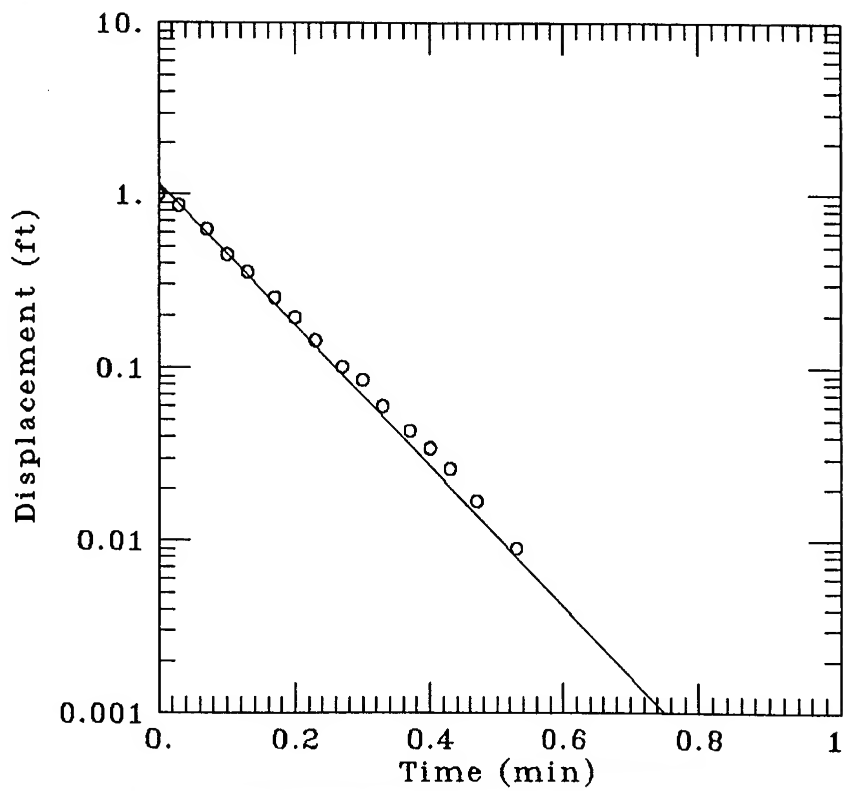
DATA SET:
c:\aq\mw1127r1.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002237 ft/min
y0 = 1.423 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1127-rising head test 2, BX Shoppette



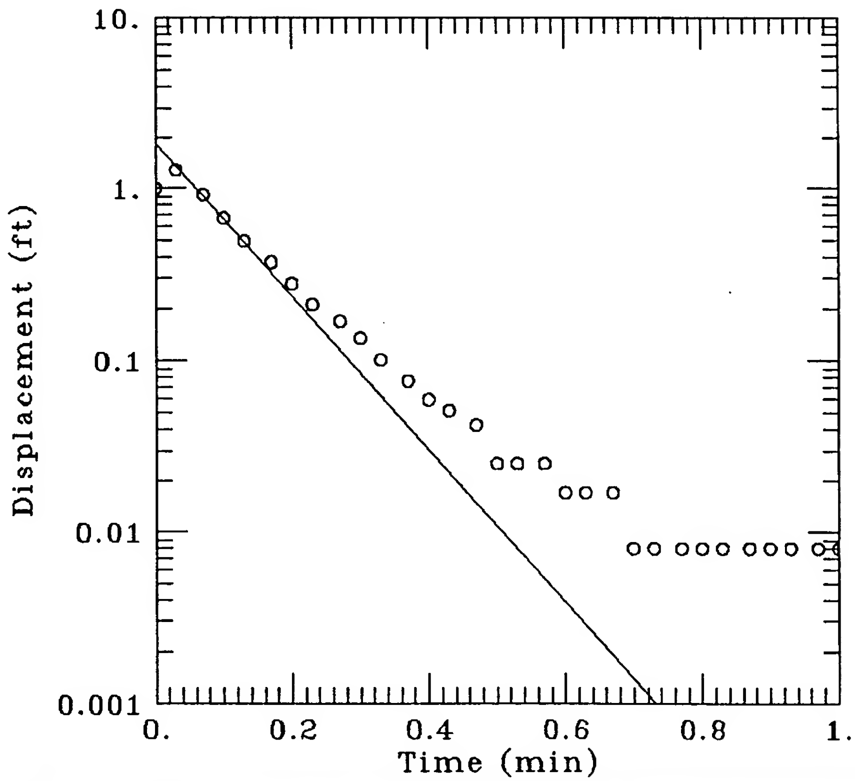
DATA SET:
c:\aq\mw1127r2.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002101 ft/min
y0 = 1.163 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1127-rising head test 3, BX Shoppette



DATA SET:
c:\aq\mw1127r3.in
04/05/96

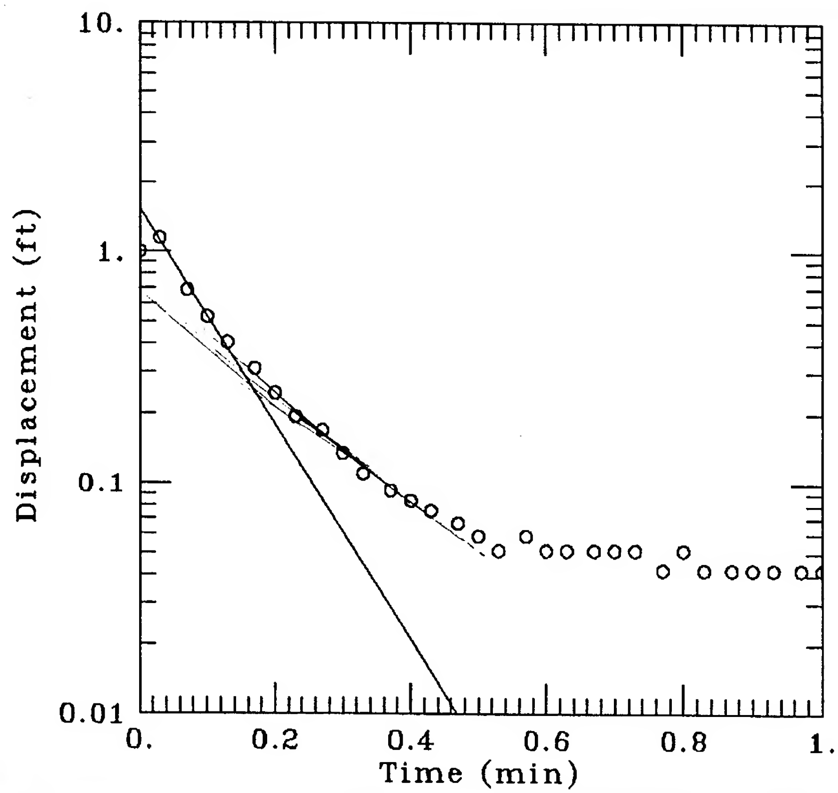
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002293 ft/min
y0 = 1.821 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1127-falling head test 2, BX Shoppette



DATA SET:
c:\aq\mw1127f2.in
04/05/96

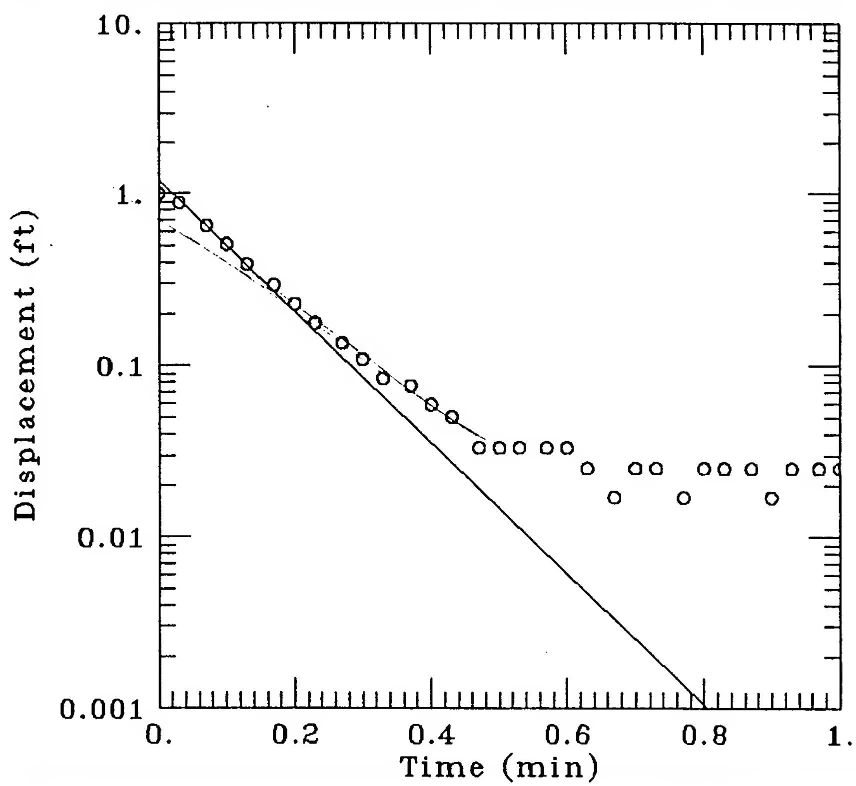
AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.002402 ft/min
y0 = 1.535 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

MW1127-falling head test 3, BX Shoppette



DATA SET:
c:\aq\mw1127f3.in
04/05/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.001968 ft/min
y0 = 1.189 ft

TEST DATA:
H0 = 1. ft
rc = 0.167 ft
rw = 0.833 ft
L = 10. ft
b = 10. ft
H = 1. ft

WHITE LAND SURVEYING

Tim White, RLS AR-MO
3790 North Co. Road #667
Blytheville, AR 72315
(501) 762-5645
1-800-474-0105

TODD HERRINGTON
PARSONS ENGINEERING SCIENCE, INC.
1700 BROADWAY, SUITE 900
DENVER, CO 80290

Dear Todd;

I have enclosed, along with your map, a diskette which can be used with your company's AutoCAD system. The DXF and ASCII files consist of coordinates and elevations of all surveyed points, and the DWG file is the plan view, which is also enclosed.

Thanks for the opportunity of working with you and your company. If you should have any questions, please feel free to call.

Sincerely,

Tim White 4/3/96

Tim White, RLS1241

SURVEY LOCATIONS (MONITORING WELLS, ETC.) AT THE BX SERVICE STATION, EAKER AIR FORCE BASE, BLYTHEVILLE, ARKANSAS.

Surveyed & prepared by: White Land Surveying
Blytheville, AR
(501) 762-5645
1-800-474-0105

For: Parsons Engineering Science, Inc.
Denver, CO

REGISTERED STATE OF ARKANSAS NO. 1241 SIGNATURE TIM L. WHITE PROFESSIONAL LAND SURVEYOR

HORIZONTAL DATUM = NAD27 VERTICAL DATUM = NAVD88

PT.#	NORTHING	EASTING	ELEV.	DESCRIPTION
1-	599296.31	2604671.34	248.74	MON. "FOURTH MSL"
2-	598983.47	2605707.85	0.00	MON. "COMBAT"
3-	599527.42	2604778.67	252.64	TW1125, TOC
4-	599526.41	2604780.50	249.57	TW1125, GROUND
5-	599416.63	2604766.40	242.89	BANK, NE/SW DITCH
6-	599417.72	2604764.94	242.96	TOP OF WATER, SAME
7-	599418.00	2604762.27	241.66	BOTTOM OF DITCH, SAME
8-	599531.66	2604838.12	242.86	BANK, NE/SW DITCH
9-	599533.45	2604836.59	242.92	TOP OF WATER, SAME
10-	599534.39	2604835.26	241.59	BOTTOM OF DITCH, SAME
11-	599659.64	2604910.06	242.71	CCC, TOP OF BANK
12-	599661.89	2604908.19	242.92	CCC, TOP OF WATER
13-	599661.32	2604902.68	242.14	CCC, BOTTOM OF DITCH
14-	599522.92	2604911.06	250.70	ESSB-25, GROUND
15-	599447.45	2604838.22	250.70	TW1120, TOC
16-	599447.21	2604838.92	250.85	TW1120, GROUND
[illegible]-	599335.66	2604815.53	249.51	ESS18, GROUND
[illegible]-	599334.85	2604814.31	249.58	18ESLF, GROUND
19-	599355.32	2604845.79	249.35	TW1115, TOC
20-	599355.22	2604846.14	249.53	TW1115, GROUND
21-	599426.89	2604884.87	252.72	TW1123, TOC
22-	599425.34	2604886.19	250.33	TW1123, GROUND
23-	599440.61	2604894.42	253.13	TW1124, TOC
24-	599438.98	2604895.62	250.53	TW1124, GROUND
25-	599513.94	2604985.04	250.62	TW1114, TOC
26-	599513.41	2604985.35	250.80	TW1114, GROUND
27-	599488.96	2605029.03	252.19	TW1122, TOC
28-	599487.43	2605030.08	249.70	TW1122, GROUND
29-	599453.73	2605056.64	250.25	16ESLF, GROUND
30-	599446.02	2605047.07	250.31	TW1111, TOC
31-	599446.51	2605046.81	250.43	TW1111, GROUND
32-	599432.75	2605055.80	250.59	17ESLF, GROUND
33-	599436.22	2605031.52	250.59	15ESLF, GROUND
34-	599410.72	2604970.12	250.48	TW1101, TOC
35-	599410.96	2604969.66	250.61	TW1101, GROUND
36-	599388.01	2604999.77	250.63	ESSB-24, GROUND
37-	599382.70	2604982.96	250.41	14ESLF, GROUND
38-	599377.99	2604957.36	250.42	J SAMPLE, GROUND
39-	599356.27	2604925.71	249.92	TW1106, TOC
40-	599355.80	2604925.84	250.12	TW1106, GROUND
41-	599348.97	2604940.56	249.74	12ESLF, GROUND
[illegible]-	599301.35	2604930.41	248.47	TW1102, TOC
[illegible]-	599301.67	2604930.42	248.67	TW1102, GROUND
44-	599337.51	2604974.83	249.97	ESMP-23, GROUND
45-	599340.74	2604974.68	249.85	23ESLF, GROUND
46-	599344.85	2604981.22	250.13	ESSB-29, GROUND
47-	599343.28	2604981.44	250.15	13ESLF, GROUND

48-	599340.65	2604984.33	250.12	TW1105, TOC
49-	599341.07	2604984.19	250.31	TW1105, GROUND
50-	599318.25	2605021.07	249.67	10ESLF, GROUND
51-	599319.43	2604996.46	249.12	CPT-22, TOC
52-	599319.72	2604996.18	249.34	CPT-22, GROUND
53-	599293.75	2605004.39	249.18	TW1108, TOC
54-	599294.23	2605004.31	249.53	TW1108, GROUND
55-	599301.66	2605020.00	249.65	ESSB-27, GROUND
56-	599350.84	2605059.69	250.06	ESSB-28, GROUND
57-	599343.01	2605061.21	250.11	MW1128, TOC
58-	599343.68	2605060.99	250.35	MW1128, GROUND
59-	599395.89	2605069.31	250.70	22ESFL/ESSB22, GND
60-	599381.05	2605116.10	250.45	MW1104, TOC
61-	599381.60	2605115.99	250.63	MW1104, GROUND
62-	599398.85	2605116.62	251.21	ESMP-19S, TOC
63-	599399.75	2605116.31	251.19	ESMP-19S, GROUND
64-	599298.78	2604978.97	248.81	11ESLF, GROUND
65-	599284.05	2605003.11	249.43	ESSB-26, GROUND
66-	599269.94	2605047.82	249.84	TW1109, TOC
67-	599270.28	2605047.60	250.03	TW1109, GROUND
68-	599285.49	2605062.49	250.21	TW1110, TOC
69-	599285.11	2605062.44	250.35	TW1110, GROUND
70-	599361.75	2605095.14	250.32	BX BLDG. CORNER
71-	599319.60	2605054.39	251.02	BX BLDG. CORNER
72-	599302.75	2605071.80	251.03	BX BLDG. CORNER
73-	599257.68	2605123.63	250.21	BX BLDG. CORNER
74-	599301.37	2605069.68	250.98	COR. OF CANOPY
75-	599319.12	2605051.35	250.95	COR. OF CANOPY
76-	599262.99	2604997.12	249.53	COR. OF CANOPY
77-	599245.16	2605015.72	249.53	COR. OF CANOPY
78-	599114.23	2605089.37	248.95	C/L 3RD, C/L AR AVE.
79-	599208.21	2604990.65	248.30	C/L 3RD, P.C.
80-	599263.26	2604912.89	247.86	C/L 3RD, P.O.C.
81-	599273.71	2604860.25	247.81	C/L 3RD, P.T.
82-	599272.77	2604708.60	248.49	C/L 3RD @ DITCH
83-	599182.29	2604946.92	249.72	MW1127, TOC
84-	599182.92	2604947.40	249.90	MW1127, GROUND
85-	599187.57	2604940.78	249.55	MW1116, TOC
86-	599188.13	2604941.16	249.89	MW1116, GROUND
87-	599177.18	2605359.51	248.72	TURNING POINT
88-	599198.74	2605113.41	248.64	MW1119, TOC
89-	599198.43	2605113.32	248.86	MW1119, GROUND
90-	599123.74	2605141.50	249.27	ESMP-7S, TOC
91-	599124.54	2605141.16	249.26	ESMP-7S, GROUND
92-	599202.63	2605253.95	249.35	ESMP-6D, TOC
93-	599203.68	2605253.10	249.55	ESMP-6D/6S, GROUND
94-	599204.77	2605252.01	249.41	ESMP-6S, TOC
95-	599231.25	2605347.22	242.94	DDD, BANK
96-	599232.26	2605348.06	242.79	DDD, TOP OF WATER
97-	599233.72	2605349.21	241.79	DDD, BOTTOM OF DITCH
98-	599313.82	2605207.19	252.80	MW1126, TOC
99-	599315.66	2605208.02	250.01	MW1126, GROUND
100-	599307.39	2605212.01	252.24	MW1121, TOC
101-	599309.53	2605213.40	249.86	MW1121, GROUND
102-	599298.62	2605162.27	248.97	ESMP-20S, GROUND
103-	599303.75	2605161.74	249.02	20ESLF, GROUND
104-	599320.02	2605155.91	249.43	21ESLF, GROUND
105-	599416.04	2605152.00	243.01	BBB, BANK
106-	599418.31	2605154.06	242.82	BBB, TOP OF WATER
107-	599419.43	2605155.65	242.06	BBB, BOTTOM OF DITCH
108-	599317.42	2605140.95	250.09	BX BLDG. CORNER
109-	599299.99	2605124.31	250.96	BX BLDG. CORNER
110-	599279.69	2605144.83	251.01	BX BLDG. CORNER

111-	599433.23	2605219.08	251.62	ESMP-2S, TOC
112-	599432.28	2605219.72	251.65	ESMP-2D, TOC
113-	599431.45	2605220.95	251.47	ESMP-2S/2D, GROUND
114-	599543.34	2605194.96	252.04	ESMP-4S, TOC
115-	599542.74	2605194.32	252.08	ESMP-4S, GROUND
116-	599538.88	2605107.12	251.36	ESMP-3S, TOC
117-	599538.36	2605106.40	251.56	ESMP-3S, GROUND
118-	599471.44	2605273.69	251.22	ESMP-5S, TOC
[illegible]-	599471.77	2605274.63	251.25	ESMP-5S, GROUND
120-	599418.91	2605339.00	248.83	ESMP-9S, TOC
121-	599419.29	2605339.90	248.94	ESMP-9S, GROUND
122-	599238.12	2605417.29	251.41	ESMP-8S, TOC
123-	599239.08	2605416.65	251.48	ESMP-8S, GROUND

APPENDIX B

PREVIOUS ANALYTICAL AND UNPUBLISHED DATA

APPENDIX B
SUMMARY OF PREVIOUS SOIL ANALYTICAL DATA
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Borehole ID	Date	Depth (ft bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzne (mg/kg)	Total Xylenes (mg/kg)	Total BTEX (mg/kg)	TPH (mg/kg)
B-1	2/91	5-10[a/]	6.2	47	14	80	147.2	322
		15	2.4	8.2	4.5	17	32.1	176
B-2	2/91	5-10	2.3	24	7.7	40	74	248
		15	3.1	8.6	0.3	2.1	14.1	478
B-3	2/91	5-10	14	250	62	300	626	338
		15	3.6	16	1.8	9.8	31.2	176
B-4	2/91	5-10	ND[b/]	22	3.7	14	39.7	484
		15	ND	ND	ND	ND	ND	477
B-5	2/91	5-10	15	130	22	90	257	559
		15	2.4	15	3.9	16	37.3	351
B-6	2/91	5-10	1.5	18	2.5	14	36	218
		15	1.6	6.2	1	4.6	13.4	147
B-7	2/91	5-10	3.8	44	7.3	44	99.1	212
		15	1.1	0.9	0.2	0.1	2.3	247
B-8	2/91	5-10	5	27	7	39	78	157
		15	ND	ND	ND	ND	ND	163
B-9	2/91	5-10	7.6	43	16	88	154.6	136
		15	1.6	1.4	0.2	0.5	3.7	179
B-10	2/91	5-10	11	72	20	110	213	152
		15	ND	ND	ND	ND	ND	203
B-11	2/91	5-10	3.2	15	2.8	14	35	234
		15	1.9	5.2	0.6	2.2	9.9	240
B-12	2/91	5-10	6.3	35	8.2	44	93.5	207
		15	1.6	5.2	0.5	2.4	9.7	210
B-13	6/91	5-10	5.3	24	6.8	33	69.1	<30
		15	0.7	1.1	ND	0.4	2.2	<30
		20	0.8	1.2	0.2	0.8	3	<30
B-15	6/91	5-10	5.1	4.2	9.4	73	91.7	46
		15	7.9	30	6.1	27	71	<30
		20	3.7	16	4.5	24	48.2	35
B-16	6/91	5-10	9	37	11	46	103	<30
		15	ND	ND	ND	ND	ND	<30
		20	ND	ND	ND	0.5	0.5	<30
B-17	6/91	5-10	2.3	13	4.3	26	45.6	<30
B-18	6/91	5-10	7.2	20	3.7	22	52.9	<30
		15	6.2	19	5.2	24	54.4	<30
B-19	6/91	5-10	0.5	3	5.4	19	27.9	<30
		15	0.6	1.8	ND	0.7	3.1	<30
		20	0.7	1.9	0.3	0.8	3.7	<30

APPENDIX B
SUMMARY OF PREVIOUS SOIL ANALYTICAL DATA (CONCLUDED)
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Borehole ID	Date	Depth (ft bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzne (mg/kg)	Total Xylenes (mg/kg)	Total BTEX (mg/kg)	TPH (mg/kg)
B-20	6/91	5-10	3.3	26	ND	26	55.3	<30
		15	37	280	68	400	785	<30
		20	14	130	31	160	335	<30
B-21	6/91	5-10	18	84	15	100	217	30
		15	13	54	18	83	168	64
		20	8.4	22	4.7	27	62.1	<30
B-22	6/91	5-10	5.3	32	7.5	44	88.8	<30
		15	15	65	10	51	141	<30
B-23	6/91	5-10	1	17	7.1	28	53.1	<30
		15	0.6	2	1.9	7.8	12.3	<30
B-24	6/91	5-10	1.3	17	11	29	58.3	<30
		15	0.2	2.3	1.6	7.1	11.2	<30
		20	0.2	0.6	0.2	0.9	1.9	<30
B-25	6/91	5-10	4.4	28	7.9	44	84.3	<30
		15	0.2	0.8	0.1	0.8	1.9	<30
B-27	6/91	5-10	2.4	23	9.2	36	70.6	<30
		15	1.1	10	1.6	15	27.7	<30
TW1103	12/11/95	3	< 1	< 1	< 1	3	3	<20
		10	< 1	< 1	< 1	< 1	< 1	<20
		22	ND	< 1	< 1	< 1	< 1	<20
TW1108	12/14/95	5	< 1	< 1	< 1	3	3	<20
		17	< 1	< 1	1	4	5	<20
		21	< 1	< 1	< 1	< 1	< 1	<20
TW1109	12/14/95	6	5	17	17	78	123	172
		10	< 1	< 1	< 1	< 1	< 1	<20
		18	< 1	< 1	< 1	< 1	< 1	<20
TW1110	12/14/95	6-7	2	58	19	93	172	23
		8.5	1	19	< 1	51	71	<20
		16.5	< 1	3	< 1	3	6	<20
MW1121A	4/8/95	NA[c]	ND	ND	ND	ND	ND	ND
MW1122A	4/7/95	NA	< 1	< 1	ND	ND	< 1	ND
MW1123A	8/11/95	NA	ND	ND	ND	ND	ND	ND
SB1129A	4/6/95	NA	ND	ND	ND	ND	ND	ND
SB1130A	4/6/95	NA	ND	ND	ND	ND	ND	ND
SB1131A	4/7/95	NA	< 1	< 1	ND	ND	< 1	ND
SB1132A	4/9/95	NA	ND	ND	ND	ND	ND	ND
SB1133A	4/7/95	NA	ND	ND	ND	ND	ND	ND
SB1134A	4/8/95	NA	ND	ND	ND	ND	ND	ND
SB1135A	4/7/95	NA	0.9	2.7	1.1	5.4	10.1	38
SB1135B	4/7/95	NA	6.1	27	15	74	122.1	570

[a] 5-10 foot samples were composited at 5 and 10 feet.

[b] ND = not detected.

[c] NA = data not available.

Sources: Halliburton NUS, 1992 and 1995.

pace ANALYTICAL SERVICES, INC.

DATE: 12/04/95
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Brown & Root Environmental
800 Oak Ridge Turnpike
Suite A-600
Oak Ridge, TN 37830

PACE Project Number: 607292
Client Project ID: Eaker AFB - 0114
SDG Number: BR7292

Attn: Mr. Mike Albert
Phone: 615-483-9900

PACE Sample No: 60544772
Client Sample ID: E11-GW-MW1125

Date Collected: 11/08/95
Date Received: 11/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnote
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.02	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Chloride(AutoFerricyanide)								
Chloride	3	mg/L	1	11/21/95	EPA 325.2	WOC		
Total Dissolved Solids								
Total Dissolved Solids	244	mg/L	5	11/14/95	EPA 160.1	MJW		
Total Suspended Solids								
Total Suspended Solids	ND	mg/L	5	11/14/95	EPA 160.2	MJW		
Fluoride								
Fluoride	0.4	mg/L	0.1	11/30/95	EPA 340.2	GMF	16984-48-8	
fate, Total								
ulfate, Total	20	mg/L	1	11/22/95	EPA 375.3	WOC		
osphorus, Total								
Phosphorus	ND	mg/L	0.05	11/28/95	EPA 365.2	MJW	7723-14-0	
Alkalinity, Total								
Alkalinity, Total	190	mg/L	1	11/20/95	EPA 310.1	WOC		
Bromide								
Bromide	ND	mg/L	0.5	11/30/95	EPA 300	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	0.7	mg/L	0.5	11/13/95	EPA Mod 8015 pur	BDT		
a,a,a-Trifluorotoluene (S)	77	%		11/13/95	EPA Mod 8015 pur	BDT	2164-17-2	
Aromatic Volatile Organics								
Benzene	40	ug/L	2	11/13/95	EPA 8020	BDT	71-43-2	
Ethyl Benzene	ND	ug/L	2	11/13/95	EPA 8020	BDT	100-41-4	
Toluene	ND	ug/L	2	11/13/95	EPA 8020	BDT	108-88-3	
Xylene (Total)	ND	ug/L	5	11/13/95	EPA 8020	BDT	1330-20-7	
a,a,a-Trifluorotoluene (S)	98	%		11/13/95	EPA 8020	BDT	2164-17-2	

pace ANALYTICAL SERVICES, INC.

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PACE Project Number: 607292
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60544780
Client Sample ID: E11-GW-MW1126

Date Collected: 11/08/95
Date Received: 11/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Foo:
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.03	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Nitrogen, Nitrate	0.05	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.08	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Chloride(AutoFerricyanide)								
Chloride	5	mg/L	1	11/21/95	EPA 325.2	WOC		
Total Dissolved Solids								
Total Dissolved Solids	212	mg/L	5	11/16/95	EPA 160.1	MJW		
Total Suspended Solids								
Total Suspended Solids	16	mg/L	5	11/14/95	EPA 160.2	MJW		
Fluoride								
Fluoride	0.2	mg/L	0.1	11/30/95	EPA 340.2	GMF	16984-48-8	
Sulfate, Total								
Sulfate, Total	29	mg/L	1	11/22/95	EPA 375.3	WOC		
Phosphorus, Total								
Phosphorus	ND	mg/L	0.05	11/28/95	EPA 365.2	MJW	7723-14-0	
Alkalinity, Total								
Alkalinity, Total	96	mg/L	1	11/20/95	EPA 310.1	WOC		
Bromide								
Bromide	ND	mg/L	0.5	11/30/95	EPA 300	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	11/13/95	EPA Mod 8015 pur	BDT		
a,a,a-Trifluorotoluene (S)	76	%		11/13/95	EPA Mod 8015 pur	BDT	2164-17	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	11/13/95	EPA 8020	BDT	71-43-2	
Ethyl Benzene	ND	ug/L	2	11/13/95	EPA 8020	BDT	100-41-4	
Toluene	ND	ug/L	2	11/13/95	EPA 8020	BDT	108-88-3	
Xylene (Total)	ND	ug/L	5	11/13/95	EPA 8020	BDT	1330-20-7	
a,a,a-Trifluorotoluene (S)	94	%		11/13/95	EPA 8020	BDT	2164-17-2	

PACE ANALYTICAL SERVICES, INC.

DATE: 12/04/95
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PACE Project Number: 607292
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60546298
Client Sample ID: E11-GW-MW1127

Date Collected: 11/09/95
Date Received: 11/10/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnot
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.03	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Chloride(AutoFerricyanide)								
Chloride	4	mg/L	1	11/21/95	EPA 325.2	WOC		
Total Dissolved Solids								
Total Dissolved Solids	272	mg/L	5	11/14/95	EPA 160.1	MJW		
Total Suspended Solids								
Total Suspended Solids	97	mg/L	5	11/14/95	EPA 160.2	MJW		
Fluoride								
Fluoride	0.3	mg/L	0.1	11/30/95	EPA 340.2	GMF	16984-48-8	
Sulfate, Total								
Sulfate, Total	11	mg/L	1	11/22/95	EPA 375.3	WOC		
Phosphorus, Total								
Phosphorus	0.76	mg/L	0.05	11/28/95	EPA 365.2	MJW	7723-14-0	
Alkalinity, Total								
Alkalinity, Total	210	mg/L	1	11/20/95	EPA 310.1	WOC		
Bromide								
Bromide	ND	mg/L	0.5	11/30/95	EPA 300	WOC		
C -- Volatiles								
H, Water, Purge by Mod. 8015								
otal Petroleum Hydrocarbons	ND	mg/L	0.5	11/16/95	EPA Mod 8015 pur	BDT		
a,a,a-Trifluorotoluene (S)	77	%		11/16/95	EPA Mod 8015 pur	BDT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	11/16/95	EPA 8020	BDT	71-43-2	
Ethyl Benzene	ND	ug/L	2	11/16/95	EPA 8020	BDT	100-41-4	
Toluene	ND	ug/L	2	11/16/95	EPA 8020	BDT	108-88-3	
Xylene (Total)	ND	ug/L	5	11/16/95	EPA 8020	BDT	1330-20-7	
a,a,a-Trifluorotoluene (S)	99	%		11/16/95	EPA 8020	BDT	2164-17-2	

PACE ANALYTICAL SERVICES, INC.

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PACE Project Number: 607292
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60546306
Client Sample ID: E11-GW-MW1128

Date Collected: 11/09/95
Date Received: 11/10/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Foot
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.03	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.03	mg/L	0.01	11/10/95	EPA 354.1	WOC		
Chloride(AutoFerricyanide)								
Chloride	19	mg/L	1	11/21/95	EPA 325.2	WOC		
Total Dissolved Solids								
Total Dissolved Solids	277	mg/L	5	11/14/95	EPA 160.1	MJW		
Total Suspended Solids								
Total Suspended Solids	29	mg/L	5	11/14/95	EPA 160.2	MJW		
Fluoride								
Fluoride	0.2	mg/L	0.1	11/30/95	EPA 340.2	GMF	16984-48-8	
Sulfate, Total								
Sulfate, Total	30	mg/L	1	11/22/95	EPA 375.3	WOC		
Phosphorus, Total								
Phosphorus	0.68	mg/L	0.05	11/28/95	EPA 365.2	MJW	7723-14-0	
Alkalinity, Total								
Alkalinity, Total	180	mg/L	1	11/20/95	EPA 310.1	WOC		
Bromide								
Bromide	ND	mg/L	0.5	11/30/95	EPA 300	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	11/17/95	EPA Mod 8015 pur	BDT		
a,a,a-Trifluorotoluene (S)	78	%		11/17/95	EPA Mod 8015 pur	BDT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	11/17/95	EPA 8020	BDT	71-43-2	
Ethyl Benzene	ND	ug/L	2	11/17/95	EPA 8020	BDT	100-41-4	
Toluene	ND	ug/L	2	11/17/95	EPA 8020	BDT	108-88-3	
Xylene (Total)	ND	ug/L	5	11/17/95	EPA 8020	BDT	1330-20-7	
a,a,a-Trifluorotoluene (S)	103	%		11/17/95	EPA 8020	BDT	2164-17-2	

Rick McComb
AFBCA/OL-J
Eaker AFB
Gosnell, AR 72319-0400

Saskia Hoffer
Parsons Engineering Science
1700 Broadway Ste. #900
Denver, CO 80290

Dear Saskia:
The enclosed information is the UST excavation and sampling information you requested regarding the four UST's removed at the BX Shoppette. If there is anything else you need please contact Jerry Branum, Randall Looney or myself here on base.

Rick McComb

Rick McComb

TABLE 4: UST CONFIRMATORY SAMPLE ANALYTICAL RESULTS

TANK ID	SAMPLE NO.	DATE SAMPLED	SUMMARY OF LABORATORY DATA					
			VOCs (ug/kg)	TPH PURGABLE (mg/kg)	TPH EXTRACTABLE (mg/kg)	RCRA METALS (mg/kg)	PESTICIDES PCBs (mg/kg)	SEMI-VOCs (ug/kg)
106	OWS-106-1	11/19/95	ND	ND	ND	Selenium - 29	ND	ND
160A	NOT SAMPLES	-	-	-	-	-	-	-
160B	NOT SAMPLED	-	-	-	-	-	-	-
160C	NOT SAMPLED	-	-	-	-	-	-	-
160D	US-160D-1	9/27/95	Methyl Chloride - 6.1	ND	ND	Selenium - 28.9	ND	ND
203	UST-203-1	11/6/95	ND	ND	ND	Silver - 3.77	ND	ND
204	US-204-1	11/14/95	Benzene - 1900 Ethyl Benzene - 540 Xylenes - 540	TPH - 600	Jet Fuel - 800	Selenium - 20.6	PCB - (1254) - 93	Napthalene 4800 2-Methylnapthalene - 1300
	204-B1	11/13/95	ND	ND	ND	NA	NA	NA
	204-B2	11/13/95	Ethyl Benzene - 1000 Toluene - 890 Xylenes - 650	TPH - 180	Jet Fuel - 240	NA	NA	NA
	204-B3	11/13/95	ND	ND	ND	NA	NA	NA
	204-B4	11/13/95	Ethyl Benzene - 1100 Toluene - 960 Xylenes - 1000	TPH - 440	Jet Fuel - 1500	NA	NA	NA
	204-B5	11/14/95	Ethyl Benzene - 700 Xylenes - 420	TPH - 150	Jet Fuel - 270	NA	NA	NA
	204-B7	11/14/95	ND	ND	Jet Fuel - 22	NA	NA	NA
214A	US-214A-1	11/6/95	ND	ND	ND	BB	ND	ND
214B	US-214B-1	11/10/95	ND	TPH - 6.2	Diesel Fuel - 35	BB	ND	Napthalene - 170 2-Methylnapthalene - 83

TABLE 6: QUANTITY AND ORIGIN OF UST/OWS PCS PLACED INTO BIOCELLS

Eaker AFB
UST & OWS Removal Project - Soil Quantity and Origin
Contract No. F41624-94-D-8094 Delivery Order No. 0002

UST			OWS			Existing Biocells		
Vessel No.	Qunnity Excavated	Biocell	Vessel No.	Quantity Excavated	Biocell	Cell Location	Quantity Transfered	Biocell
160 A	150 CY	BX	106	50 CY	BX	WSA 2	500 CY	BX
160 B	150 CY	BX	214	15 CY	BX	WSA 5	100 CY	BX
160 C	150 CY	BX	237	15 CY	BX	WSA 7	100 CY	BX
160 D	150 CY	BX	410	15 CY	BX	WSA 8	50 CY	BX
204	400 CY	BX	412	45 CY	BX	WSA 9	150 CY	BX
[illegible]03	10 CY	BX	452	40 CY	BX	WSA 11	50 CY	BX
[illegible]	15 CY	BX	453	40 CY	BX	WSA 12E	50 CY	BX
410 A	550 CY	RV	455 B	250 CY	BX	WSA 12W	50 CY	BX
410 B	550 CY	RV	467	250 CY	BX	CM 14	200 CY	BX
410 C	550 CY	RV	468 A	75 CY	BX	FR 15	50 CY	BX
410 D	550 CY	RV	1236	250 CY	BX	FR 16	150 CY	BX
410 E	550 CY	RV	1305	10 CY	BX	RV 19	50 CY	RV
410 F	550 CY	RV	1344	130 CY	BX	RV 20	150 CY	RV
410 G	550 CY	RV						
410 H	550 CY	RV						
455	550 CY	RV						
1288	20 CY	BX						
1344 A	175 CY	BX						
1344 B	175 CY	BX						
TOTAL	6345 CY			1185 CY			1650 CY	

TOTAL SOIL IN NEW CELLS 9180 CY

UNDERGROUND STORAGE TANK CONTENTS
SAMPLING CHART

R&R International, Inc.
Eaker AFB - 206179.0002

Tank	Date Sampled	Duplicate	Analysis	Date Shipped	Data Recieved
410A	7-26-95		a,b,c,d,e,f,g	7-26-95	YES
410B	7-26-95		a,b,c,d,e,f,g	7-26-95	YES
410C	7-26-95		a,b,c,d,e,f,g	7-26-95	YES
410D	7-26-95		a,b,c,d,e,f,g	7-26-95	YES
410E	7-26-95		a,b,c,d,e,f,g	7-26-95	YES
410F	7-26-95		a,b,c,d,e,f,g	7-26-95	YES
410G	7-26-95		a,b,c,d,e,f,g	7-26-95	YES
410H	7-26-95		a,b,c,d,e,f,g	7-26-95	YES
160A	7-27-95		a,b,c,d,e,f,g	7-27-95	YES
160B	7-27-95		a,b,c,d,e,f,g	7-27-95	YES
160C	7-28-95		a,b,c,d,e,f,g	7-28-95	YES
160D	7-27-95		a,b,c,d,e,f,g	7-27-95	YES
468	7-27-95		a,b,c,d,e,f,g	7-27-95	YES
214	7-27-95		a,b,c,d,e,f,g	7-27-95	YES
1344A	7-30-95	1344B	a,b,c,d,e,f,g	8-1-95	YES
1344C	7-30-95		a,b,c,d,e,f,g	8-1-95	YES
204A	7-30-95	204B	a,b,c,d,e,f,g	8-1-95	YES
455	7-30-95 (7-31)		a,b,c,d,e,f,g	8-1-95	YES
203	8-3-95 & 8-6-95		a,b,c,d,e,f,g	8-3-95 & 8-7-95	YES
214B	8-3-95		a,b,c,d,e,f,g	8-3-95	YES
106	not sampled				
412	not sampled				
250	see note				

Notes:
a = TCLP 8040 VOCs
b = TCLP 8270 S.VOCs
c = TCLP 8080 PEST
d = TCLP 6010/7470 Metals/Mercury
e = 8080 PCBs
f = 9045 pH
g = 1010 Ignitability

- A second tank at Bldg. 214 was located and sampled
- UST 250 does not exist .
- Resampled UST 203 for PCBs (short 1 jar 8-3-95)
- Sample 1344C is UST 1344B as identified on the removal list.
- 21 total underground storage tanks sampled
- USTs 106 and 412 were not sampled because they were located inside of OWSs 106 and 412 which were sampled

Eaker AFB
Contract No. F41624-94-D-8094 D.O. #0002
Table 1.0 - Results of UST Content Sampling

Tank ID	Sample No.	Date Sampled	Capacity (gal.)	Estimated Volume	Summary of Laboratory Data: RCRA Metals (ug/l)	Wet Chemistry	Pesticides (mg/l)	VOCs (ug/l)	Semi - VOCs (ug/l)	PCBs (ug/l)
160A	160A-TP-1	7/27/95	10,000	<1/8		FP 15°C pH 7.75	(1)			
160B	160B-TP-1	7/27/95	10,000	<1/8		FP 18°C pH 6.57	(2)			
160C	160C-TP-1	7/28/95	6,000	almost empty	Ba-522 Se-179	FP >94°C pH 5.86	ND	2-Butanone - 7500 Benzene - 2100	2-Methyphenol - 1300 3-Methyphenol - 660 4-Methyphenol (3)	ND
160D	160D-TP-1	7/27/95	200	<1/4	Ba-188 Cd-29.6 Pb-61.7	FP >94°C pH 6.52	ND	Benzene - 2800	3-Methyphenol - 300 4-Methyphenol (3)	ND
204	204A-TP-1	7/30/95	25,000	Full	Hg 0.00341 mg/l Ba-177	FP >94°C pH 7.64	ND	ND	ND	Arochlor 1254 - 41
204	204B-TP-1 Duplicate	7/30/95	N/A	N/A	Ba-193	FP >94°C pH 7.8	ND	ND	ND	Arochlor 1254 - 43
214	214-TP-1	7/27/95	550	3/4	Ba-813 Cd-115 Cr-7.7 Pb-210	FP 46.1 pH 6.73	ND	Benzene - 80	Hexachloroethane-230	ND
250			3,000		Note: This was removed under a previous contract.					

160
4 - USTs (A,B,C &D)

Appendix V - Site Specific Information

- Site Summary
- ADPC&E 30 Day Notification Letter
- Excavation Permit
- Closure Report
  - Site Maps
  - Analytical Reports
- Certificate of Tank Disposal
- ADPC&E Closure Letter

SITE SUMMARY

Site Number	160
Date UST(s) Pumped	A,B, & C - 9/21/95 D - 9/25/95
Date UST(s) Removed	9/21/95 to 9/25/95
Construction of UST(s)	A,B&C - Steel D - RFP
Actual UST Size	A&B - 10,000 gallon C - 6,000 gallon D - 550 gallon
Type of Contents	A,B,C - Gasoline D - Waste Motor Oil
Amount of Contents Removed	A,B,&C - 90 gallons D - 250 gallons
Concrete Anchor Slab Removed (Yes/No)	Yes (all)
Amount of Contaminated Soil Removed	A,B,&C - 600 Cubic Yards D - No
Confirmatory Soil Sample Number(s)	A,B,& C - Not Sampled D - US-160D-1
Sample Date(s)	9/27/95
Analytical Results (ppm):	
TEPH	ND
Total BTEX	ND
Date Backfilled	10/12/95
Type of Restoration (Seed/Concrete/Asphalt)	A,B,&C - None D - Concrete
Date UST(s) Pumped	A,B,& C - 9/21/95 D - 9/25/95
Location of UST Disposal	A,B,&C - Goolsby Scrap Facility D - Mississippi County Landfill
ADPC&E Closure Letter (Date)	Under Review

FOR STATE USE ONLY:
ARK. UST ID# ________
DATE RECEIVED ________
REFERRAL ________

STATE OF ARKANSAS
30-DAY NOTICE FOR UST PERMANENT CLOSURE
(40 CFR PART 280.71)

RETURN TO: ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY
REGULATED STORAGE TANK DIVISION
P. O. BOX 8913, LITTLE ROCK, AR 72219-8913
TELEPHONE NO. (501)562-6533

YOU MUST COMPLETE AND RETURN THIS FORM 30 DAYS PRIOR TO CLOSURE

1. OWNERSHIP OF UST SYSTEM	2. LOCATION OF TANK(S) IF SAME AS SECTION 1, CHECK HERE ☐
OWNER'S NAME: U.S. Air Force, Eaker Air Force Base	FACILITY NAME: Eaker Air Force Base
STREET ADDRESS: AFBCA/OL-J P.O. Box 9400	STREET ADDRESS: Building 160
CITY, STATE, ZIP: Gosnell, Arkansas 72319-0400	CITY, STATE, ZIP: Eaker AFB, Arkansas, 72317-5000
CONTACT PERSON, TITLE: Thomas Zachary, Environmental Engineer	CONTACT PERSON, TITLE: Thomas Zachary, Environmental Engineer

3. NUMBER OF TANKS AT LOCATION: 4 -(160A, 160B, 160C (1 pit), 160D (1 pit))

4. NUMBER OF TANKS TO BE REMOVED: 4

5. NUMBER OF TANKS TO BE CLOSED IN PLACE: 0
 a. INERT SOLID TO BE USED: N/A

6. NUMBER OF TANKS INCLUDED IN A CHANGE-OF-SERVICE: 0
 a. INDICATE TYPE OF NON-REGULATED SUBSTANCE TO BE STORED IN TANK: N/A

7. SCHEDULED DATE OF CLOSURE: Mid August 1995

8. CONTRACTOR INFORMATION:	9. LABORATORY INFORMATION:
CONTRACTOR NAME: R&R International, Inc.	LABORATORY NAME: Pace, Inc.
STREET ADDRESS: 4920 East Fifth Ave.	STREET ADDRESS: 9608 Loivet Blvd.
CITY, STATE, ZIP: Columbus, OH 43219	CITY, STATE, ZIP: Lenexa, KS 66219
AREA CODE, PHONE NUMBER: (412) 237-5700	AREA CODE, PHONE NUMBER: (913) 599-5665
CONTACT PERSON, TITLE: Harry E. Smail, Project Manager	CONTACT PERSON, TITLE: Chris Scharf, Project Manager

ARK. UST CONTRACTOR'S LICENSE NO: 851

(OVER)

5-8704

BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST	DATE PREPARED 7-31-94

1. Clearance is requested to proceed with work at Bldg 160 on Work Order/Job No. 0.0. 002, Contract No. F41624-94-0-8094, involving excavation or utility disturbance per attached sketch. The area involved ☐ Has ☑ Has not been staked or clearly marked.

2. TYPE OF FACILITY/WORK INVOLVED

A. PAVEMENTS	B. DRAINAGE SYSTEMS	C. RAILROAD TRACKS	D. FIRE DETECTION AND PROTECTION SYSTEMS	E. UTILITY ☐ OVERHEAD ☐ UNDERGROUND
F. COMM. ☐ OVERHEAD ☐ UNDERGROUND	G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW	H. SECURITY	I. OTHER *(Specify)* Removal of 4 UST's	

3. INSTRUCTIONS: *The BCE work clearance request is used for any work (contract or in house) that may disrupt aircraft or vehicular traffic flow, base utility services, protection provided by fire and intrusion alarm system, or routine activities of the installation. This form is used to coordinate the required work with key base activities and keep customer inconvenience to a minimum. It is also used to identify potentially hazardous work conditions in an attempt to prevent accidents. The work clearance request is processed just prior to the start of work. If delays are encountered and the conditions at the job site change (or may have changed) this work clearance request must be reprocessed.*

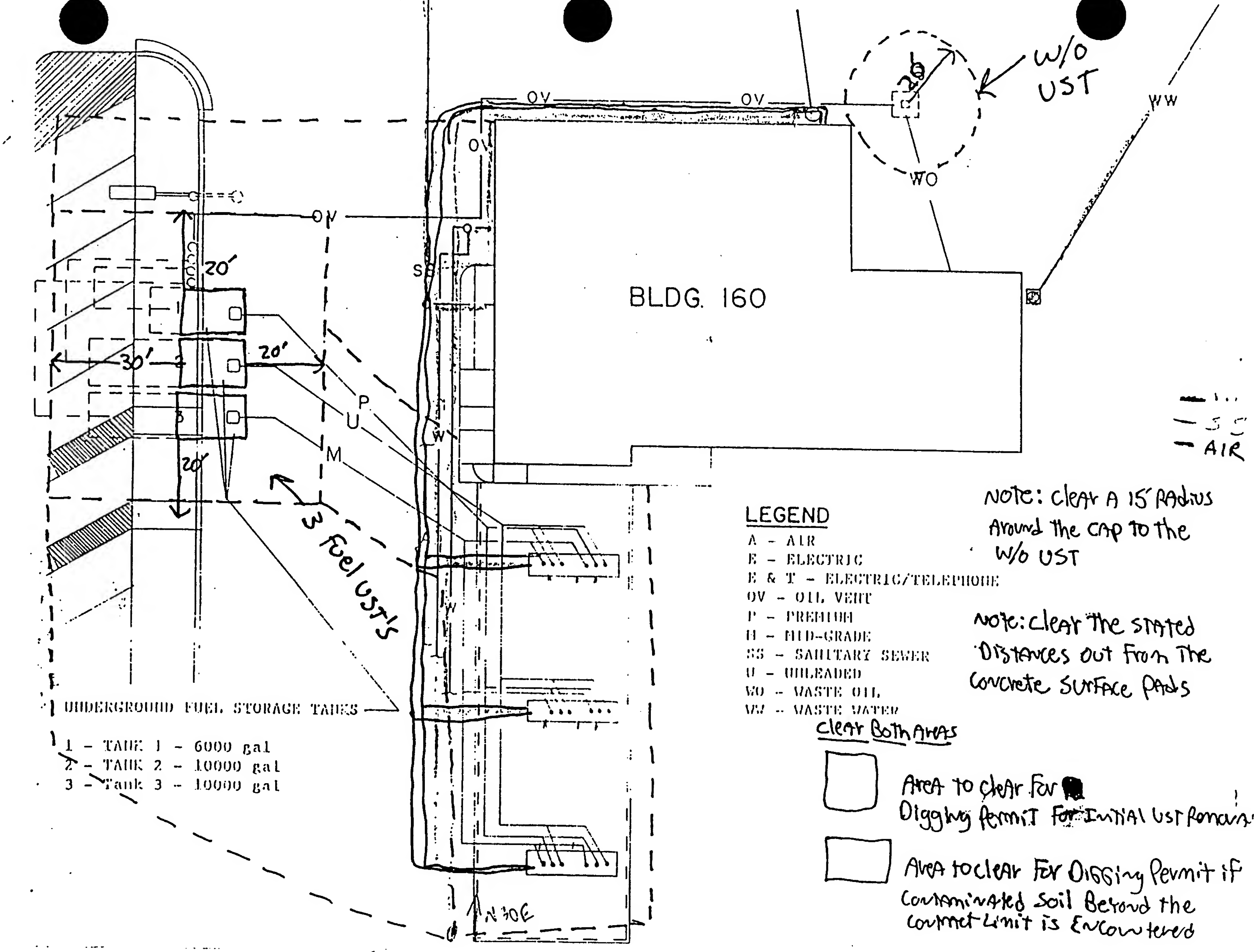
4. DATE CLEARANCE REQUIRED	5. DATE CLEARANCE TERMINATED
August 15, 1995	September 30, 1995

6. REQUESTING OFFICIAL *(Signature)*	7. PHONE NO.	8. ORGANIZATION
[signature]	501 532-6230	R&R International, Inc.

CLEARANCE REVIEW

	ORGANIZATION	REMARKS	REVIEWER'S NAME AND INITIALS
9. BASE CIVIL ENGINEERING	A. ELECTRICAL DISTRIBUTION	~~[illegible]~~ OK	[signature]
	B. STEAM DISTRIBUTION		
	C. WATER DISTRIBUTION	In Area	[signature]
	D. POL DISTRIBUTION		
	E. SEWER LINES	In Area	[signature]
	F. DRAINAGE SYSTEMS	In Area	[signature]
	G. PAVEMENTS, GROUNDS, RAILROADS		
	H. FIRE DEPARTMENT		
	I. ENGINEERING & ENVIRONMENTAL PLANNING		
	J. CATHODIC PROTECTION	OK	[signature]
	K. OTHER Gas	In Area	[signature]
10. SECURITY POLICE			
11. SAFETY			
12. COMMUNICATIONS		OK	[signature]
13. BASE OPERATIONS			
14. COMMERCIAL UTILITY COMPANY *(Telephone, Gas, Electrical, etc.)*			
15. OTHER *(Specify)* Air		In Area	[signature]

AF FORM 103, JUL 82 *(EF)* PREVIOUS EDITION WILL BE USED.



W/O UST
WW
OV
OV
OV
OV
WO
20'
BLDG. 160
SS
W
W
P
U
M
20'
20'
30'
20'
3 Fuel UST's
N 30E
UNDERGROUND FUEL STORAGE TANKS
1 - TANK 1 - 6000 gal
2 - TANK 2 - 10000 gal
3 - Tank 3 - 10000 gal
AIR
LEGEND
A - AIR
E - ELECTRIC
E & T - ELECTRIC/TELEPHONE
OV - OIL VENT
P - PREMIUM
M - MID-GRADE
SS - SANITARY SEWER
U - UNLEADED
WO - WASTE OIL
WW - WASTE WATER
Note: clear A 15' Radius Around the cap to the W/O UST
Note: clear the stated Distances out from the Concrete Surface Pads
Clear Both Areas
Area to clear for [redacted] Digging Permit For Initial UST Removal
Area to clear For Digging Permit if Contaminated Soil Beyond the Contract Limit is Encountered

FOR OFFICE USE ONLY
FACILITY ID# ____________
OWNER ACCOUNT # ____________

ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY

8001 NATIONAL DRIVE, P.O. BOX 8913, LITTLE ROCK, AR 72219-8913
TELEPHONE: 501-562-6533 FAX: 501-562-2541

CONTRACTOR'S UST PERMANENT CLOSURE REPORT

1. ARKANSAS UST I.D. #: COUNTY: MISSISSIPPI

2. DATE OF CLOSURE: 9-19-95 THRU 9-22-95

3. CONTRACTOR:
   NAME AND TITLE: PETER G. WEILERSBACHER
   COMPANY NAME: R&R INTERNATIONAL. INC.
   COMPANY PHONE: (412) 257-9120 COMPANY FAX: (412) 257-9139

4. OWNERSHIP OF UST SYSTEM:
   OWNERS NAME: U.S. AIR FORCE. EAKER AIR FORCE BASE. AFBCA/OL-J
   STREET ADDRESS: SECOND STREET. BUILDING 233. P.O. BOX 9400
   CITY: GOSNELL STATE: AR ZIP: 72319-0400
   AREA CODE/PHONE NO.: (501) 532-6550

5. LOCATION OF TANK(S): IF SAME AS SECTION 4, CHECK HERE: ______
   FACILITY NAME: BUILDING 160
   STREET ADDRESS: THIRD STREET
   CITY: EAKER AFB STATE: AR ZIP: 72317
   AREA CODE/PHONE NO.: (501) 532-6230

6. NUMBER OF TANKS AT LOCATION: 4

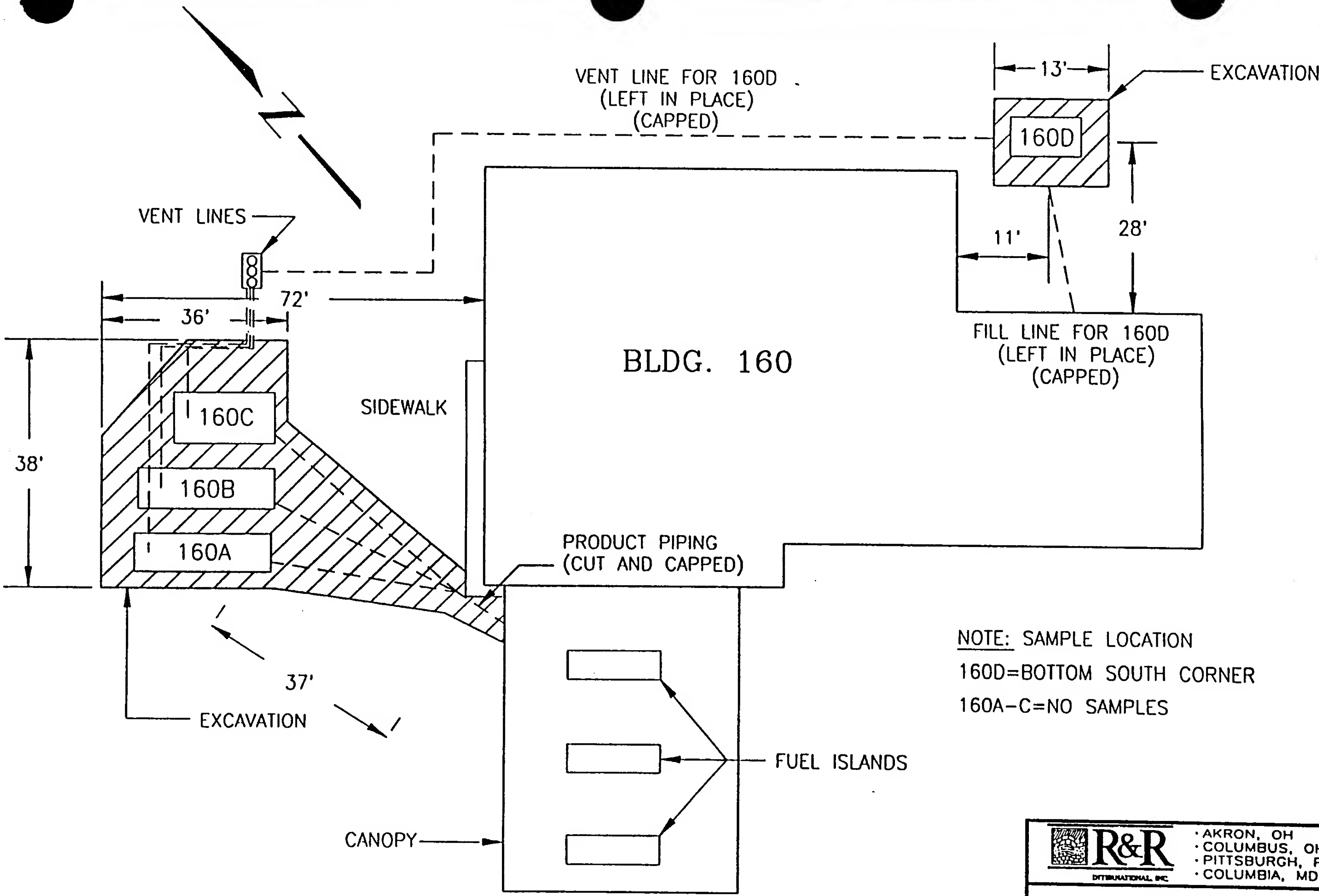
7. NUMBER OF TANKS REMOVED: 4

8. SIZE (GALLONS) & SUBSTANCE (I.E. GAS. DIESEL. ETC.) STORED IN TANK(S) REMOVED:
   2 -10.000 GALLON GASOLINE (A,B) 1-6,000 GALLON GASOLINE(C)
   1-500 GALLON WASTE MOTOR OIL (D)

9. NUMBER OF TANKS CLOSED IN PLACE: 0
   WHAT TYPE OF INERT SOLID WAS USED: N/A

10. WAS A 30-DAY NOTIFICATION OF PERMANENT CLOSURE SENT?
    YES X IF SO, DATE 7-21-95 NO ______

11. DID THE CONTRACTOR EMPTY AND CLEAN ALL THE TANKS, REMOVING ALL ACCUMULATED LIQUIDS AND/OR SLUDGE? YES X IF SO, DATE 9-26-95/9-27-95 NO ___
    DISPOSITION OF LIQUIDS AND/OR SLUDGE: LWD. INC., CALVERT CITY KENTYCY 42029



R&R INTERNATIONAL, INC

· AKRON, OH
· COLUMBUS, OH
· PITTSBURGH, PA
· COLUMBIA, MD

UST 160

SITE PLAN

CONTRACT NO. F41624-94-D-8094
DELIVERY ORDER 0002
EAKER AFB, ARKANSAS

DATE: 1/16/96	DRAWN BY: M.F.	DESIGNER: P.W.	PROJECT NO.: 206179.002

PACE INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 606698
Client Project ID: Eaker AFB Remedial Actions

PACE Sample No: 60490885 Date Collected: 09/27/95
Client Sample ID: US-160D-1 Date Received: 09/30/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Mercury, CVAAS								
Mercury	ND	mg/kg	0.123	10/06/95	EPA 7471	SYW	7439-97-6	
Metals, ICP								
Arsenic	ND	mg/kg	10.4	10/04/95	EPA 6010	KVU	7440-38-2	
Barium	176	mg/kg	0.49	10/04/95	EPA 6010	KVU	7440-39-3	
Cadmium	ND	mg/kg	0.613	10/04/95	EPA 6010	KVU	7440-43-9	
Chromium	14.6	mg/kg	0.858	10/04/95	EPA 6010	KVU	7440-47-3	
Lead	14.1	mg/kg	6.13	10/04/95	EPA 6010	KVU	7439-92-1	
Selenium	28.9	mg/kg	12.3	10/04/95	EPA 6010	KVU	7782-49-2	
Silver	ND	mg/kg	0.858	10/04/95	EPA 6010	KVU	7440-22-4	
Date Digested				10/04/95				
Organics								
Percent Moisture								
Percent Moisture	18.4	%		10/04/95		KMN		
GC -- Volatiles								
TPH, Soil, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/kg	6.1	10/04/95	EPA Mod 8015 pur	BDT		
a,a,a-Trifluorotoluene (S)	99	%		10/04/95	EPA Mod 8015 pur	BDT	2164-17-2	
GC								
Organochlorine Pesticides/PCBs								
alpha-BHC	ND	ug/kg	1.2	10/11/95	EPA 8080	AFT	319-84-6	
beta-BHC	ND	ug/kg	2.4	10/11/95	EPA 8080	AFT	319-85-7	
delta-BHC	ND	ug/kg	3.6	10/11/95	EPA 8080	AFT	319-86-8	
gamma-BHC (Lindane)	ND	ug/kg	1.6	10/11/95	EPA 8080	AFT	58-89-9	
Heptachlor	ND	ug/kg	1.2	10/11/95	EPA 8080	AFT	76-44-8	
Aldrin	ND	ug/kg	1.6	10/11/95	EPA 8080	AFT	309-00-2	
Heptachlor Epoxide	ND	ug/kg	33	10/11/95	EPA 8080	AFT	1024-57-3	
Endosulfan I	ND	ug/kg	5.6	10/11/95	EPA 8080	AFT	959-98-8	
Dieldrin	ND	ug/kg	0.81	10/11/95	EPA 8080	AFT	60-57-1	
4,4'-DDE	ND	ug/kg	1.6	10/11/95	EPA 8080	AFT	72-55-9	
Endrin	ND	ug/kg	2.4	10/11/95	EPA 8080	AFT	72-20-8	
Endosulfan II	ND	ug/kg	1.6	10/11/95	EPA 8080	AFT	33213-65-9	
4,4'-DDD	ND	ug/kg	4.1	10/11/95	EPA 8080	AFT	72-54-8	
Endosulfan sulfate	ND	ug/kg	27	10/11/95	EPA 8080	AFT	1031-07-8	
4,4'-DDT	ND	ug/kg	4.8	10/11/95	EPA 8080	AFT	50-29-3	
Methoxychlor	ND	ug/kg	71	10/11/95	EPA 8080	AFT	72-43-5	
Chlordane	ND	ug/kg	5.6	10/11/95	EPA 8080	AFT	57-74-9	
Toxaphene	ND	ug/kg	97	10/11/95	EPA 8080	AFT	8001-35-2	
PCB-1016 (Arochlor 1016)	ND	ug/kg	40	10/11/95	EPA 8080	AFT	12674-11-2	

9608 Loiret Blvd.
Lenexa, KS 66219
TEL: 913-599-5665
FAX: 913-599-1759

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 606698
Client Project ID: Eaker AFB Remedial Actions

PACE Sample No: 60490885 Date Collected: 09/27/95
Client Sample ID: US-160D-1 Date Received: 09/30/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Bromodichloromethane	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	75-27-4	
1,2-Dichloropropane	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	78-87-5	
trans-1,3-Dichloropropene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	10061-02-6	
Trichloroethene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	79-01-6	
Dibromochloromethane	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	124-48-1	
1,1,2-Trichloroethane	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	79-00-5	
Benzene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	71-43-2	
cis-1,3-Dichloropropene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	10061-01-5	
Bromoform	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	75-25-2	
4-Methyl-2-Pentanone	ND	ug/kg	61	10/06/95	EPA 8240	CHL	108-10-1	
2-Hexanone	ND	ug/kg	61	10/06/95	EPA 8240	CHL	591-78-6	
Tetrachloroethene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	127-18-4	
1,1,2,2-Tetrachloroethane	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	79-34-5	
Toluene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	108-88-3	
Chlorobenzene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	108-90-7	
Ethyl Benzene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	100-41-4	
Styrene	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	100-42-5	
ylene (Total)	ND	ug/kg	6.1	10/06/95	EPA 8240	CHL	1330-20-7	
-Chloroethyl Vinyl Ether	ND	ug/kg	12	10/06/95	EPA 8240	CHL	110-75-8	
1,2-Dichloroethane-d4 (S)	102	%		10/06/95	EPA 8240	CHL	17060-07-0	
Toluene-d8 (S)	101	%		10/06/95	EPA 8240	CHL	2037-26-5	
4-Bromofluorobenzene (S)	107	%		10/06/95	EPA 8240	CHL	460-00-4	
GC/MS -- Semi-VOA								
Semivolatile Organics								
Phenol	ND	ug/kg	400	10/11/95	EPA 8270	MSR	108-95-2	
bis(2-Chloroethyl)ether	ND	ug/kg	400	10/11/95	EPA 8270	MSR	111-44-4	
2-Chlorophenol	ND	ug/kg	400	10/11/95	EPA 8270	MSR	95-57-8	
1,3-Dichlorobenzene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	541-73-1	
1,4-Dichlorobenzene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	106-46-7	
Benzyl Alcohol	ND	ug/kg	800	10/11/95	EPA 8270	MSR	100-51-6	
1,2-Dichlorobenzene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	95-50-1	
2-Methylphenol	ND	ug/kg	400	10/11/95	EPA 8270	MSR	95-48-7	
bis(2-Chloroisopropyl)ether	ND	ug/kg	400	10/11/95	EPA 8270	MSR	39638-32-9	
4-Methylphenol	ND	ug/kg	400	10/11/95	EPA 8270	MSR	106-44-5	
N-Nitroso-di-n-propylamine	ND	ug/kg	400	10/11/95	EPA 8270	MSR	621-64-7	
Hexachloroethane	ND	ug/kg	400	10/11/95	EPA 8270	MSR	67-72-1	
Nitrobenzene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	98-95-3	
Isophorone	ND	ug/kg	400	10/11/95	EPA 8270	MSR	78-59-1	
2-Nitrophenol	ND	ug/kg	400	10/11/95	EPA 8270	MSR	88-75-5	
2,4-Dimethylphenol	ND	ug/kg	400	10/11/95	EPA 8270	MSR	105-67-9	

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FAX: 913-599-1759

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 606698
Client Project ID: Eaker AFB Remedial Actions

PACE Sample No: 60490885 Date Collected: 09/27/95
Client Sample ID: US-160D-1 Date Received: 09/30/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Chrysene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	218-01-9	
bis(2-Ethylhexyl)phthalate	ND	ug/kg	400	10/11/95	EPA 8270	MSR	117-81-7	
Di-n-octylphthalate	ND	ug/kg	400	10/11/95	EPA 8270	MSR	117-84-0	
Benzo(b)fluoranthene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	205-99-2	
Benzo(k)fluoranthene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	207-08-9	
Benzo(a)pyrene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	50-32-8	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	193-39-5	
Dibenz(a,h)anthracene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	53-70-3	
Benzo(g,h,i)perylene	ND	ug/kg	400	10/11/95	EPA 8270	MSR	191-24-2	
Nitrobenzene-d5 (S)	77	%		10/11/95	EPA 8270	MSR	4165-60-0	
2-Fluorobiphenyl (S)	75	%		10/11/95	EPA 8270	MSR	321-60-8	
Terphenyl-d14 (S)	96	%		10/11/95	EPA 8270	MSR	1718-51-0	
Phenol-d5 (S)	82	%		10/11/95	EPA 8270	MSR	13127-88-3	
2-Fluorophenol (S)	85	%		10/11/95	EPA 8270	MSR	367-12-4	
2,4,6-Tribromophenol (S)	95	%		10/11/95	EPA 8270	MSR	118-79-6	
Date Extracted				10/04/95				

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ENVIRONMENTAL LABORATORIES

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60348042 Date Collected: 06/02/95
Client Sample ID: E11-GW-TW1110 Date Received: 06/03/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.06	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, Nitrate	0.06	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.12	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	917	mg/L	5	06/05/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	350	mg/L	1	06/06/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	1.23	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	3	mg/L	1	06/26/95	EPA 375.3	GMF		
Fluoride								
Fluoride	0.3	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	43	mg/L	5	06/06/95	EPA 160.2	RST		
Chloride(AutoFerricyanide)								
Chloride	200	mg/L	2	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	1.21	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	52.5	mg/L	25	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	118	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	10000	ug/L	100	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	1000	ug/L	100	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	280	ug/L	100	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	3200	ug/L	250	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	120	%		06/14/95	EPA 8020	HMF	2164-17-2	

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PACE Project Number: 605096
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60354339 Date Collected: 06/08/95
Client Sample ID: E11-GW-MW1122 Date Received: 06/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/26/95	EPA 7421	TSP	7439-92-1	
Date Digested				06/21/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.02	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Phosphorus, Total								
Phosphorus	0.55	mg/L	0.05	07/06/95	EPA 365.2	GMF	7723-14-0	
Total Dissolved Solids								
Total Dissolved Solids	168	mg/L	5	06/12/95	EPA 160.1	RST		
Total Suspended Solids								
Total Suspended Solids	13	mg/L	5	06/12/95	EPA 160.2	RST		
Sulfate, Total								
Sulfate, Total	46	mg/L	1	07/11/95	EPA 375.3	MJW		5
Fluoride								
Fluoride	ND	mg/L	0.1	06/26/95	EPA 340.2	GMF	16984-48-8	
Chloride(AutoFerricyanide)								
Chloride	ND	mg/L	1	06/30/95	EPA 325.2	WOC		
Alkalinity, Total								
Alkalinity, Total	110	mg/L	1	06/14/95	EPA 310.1	MJW		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/16/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	68	%		06/16/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/16/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/16/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/L	2	06/16/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/L	5	06/16/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	120	%		06/16/95	EPA 8020	TAT	2164-17-2	

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PACE Project Number: 606117
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60443629
Client Sample ID: E11-GW-MW1123
Date Collected: 08/24/95
Date Received: 08/25/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	09/12/95	EPA 7421	JAH	7439-92-1	
Date Digested				09/01/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	ND	mg/L	0.01	08/25/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	08/25/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	08/25/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	205	mg/L	5	08/31/95	EPA 160.1	EAH		
Alkalinity, Total								
Alkalinity, Total	140	mg/L	1	09/05/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.26	mg/L	0.05	09/11/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	14	mg/L	1	08/31/95	EPA 375.3	EAH		
Fluoride								
[illegible]uoride	0.2	mg/L	0.1	09/08/95	EPA 340.2	EAH	16984-48-8	
[illegible] Suspended Solids								
[illegible] Suspended Solids	61	mg/L	5	08/31/95	EPA 160.2	EAH		
Ch[illegible] (AutoFerricyanide)								
Ch[illegible]ide	ND	mg/L	1	09/11/95	EPA 325.2	WOC		
Bromide								
Bromide	ND	mg/L	0.5	09/08/95	EPA 300	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	09/07/95	EPA Mod 8015 pur	DJM		
a,a,a-Trifluorotoluene (S)	96	%		09/07/95	EPA Mod 8015 pur	DJM	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	09/07/95	EPA 8020	DJM	71-43-2	
Ethyl Benzene	ND	ug/L	2	09/07/95	EPA 8020	DJM	100-41-4	
Toluene	ND	ug/L	2	09/07/95	EPA 8020	DJM	108-88-3	
Xylene (Total)	ND	ug/L	5	09/07/95	EPA 8020	DJM	1330-20-7	
a,a,a-Trifluorotoluene (S)	178	%		09/07/95	EPA 8020	DJM	2164-17-2	3

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PACE Project Number: 606117
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60445897 Date Collected: 08/25/95
Client Sample ID: E11-GW-MW1124 Date Received: 08/26/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	09/12/95	EPA 7421	JAH	7439-92-1	
Date Digested				09/01/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	ND	mg/L	0.01	08/27/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	08/27/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	08/27/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	255	mg/L	5	08/31/95	EPA 160.1	EAH		
Alkalinity, Total								
Alkalinity, Total	170	mg/L	1	09/05/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.55	mg/L	0.05	09/11/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	28	mg/L	1	08/31/95	EPA 375.3	EAH		
Fluoride								
Fluoride	0.2	mg/L	0.1	09/08/95	EPA 340.2	EAH	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	15	mg/L	5	08/31/95	EPA 160.2	EAH		
Chloride(AutoFerricyanide)								
Chloride	1	mg/L	1	09/11/95	EPA 325.2	WOC		
Bromide								
Bromide	ND	mg/L	0.5	09/08/95	EPA 300	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	09/08/95	EPA Mod 8015 pur	DJM		
a,a,a-Trifluorotoluene (S)	81	%		09/08/95	EPA Mod 8015 pur	DJM	2164-17-2	
Aromatic Volatile Organics								
Benzene	62	ug/L	2	09/08/95	EPA 8020	DJM	71-43-2	
Ethyl Benzene	5.4	ug/L	2	09/08/95	EPA 8020	DJM	100-41-4	
Toluene	4.5	ug/L	2	09/08/95	EPA 8020	DJM	108-88-3	
Xylene (Total)	10	ug/L	5	09/08/95	EPA 8020	DJM	1330-20-7	
a,a,a-Trifluorotoluene (S)	70	%		09/08/95	EPA 8020	DJM	2164-17-2	

Comments : Confirmation analysis for this sample was run out of holddate.

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60348034	Date Collected:	06/02/95
Client Sample ID:	E11-GW-TW1109	Date Received:	06/03/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.1	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.06	mg/L	0.01	06/03/95	EPA 354.1	WOC		

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60346657 Date Collected: 06/01/95
Client Sample ID: E11-GW-TW1101 Date Received: 06/02/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.04	mg/L	0.01	06/02/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/02/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	06/02/95	EPA 354.1	WOC		
Phosphorus, Total								
Phosphorus	0.22	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Fluoride								
Fluoride	0.3	mg/L	0.1	06/12/95	EPA 340.2	GMF	16984-48-8	
Sulfate, Total								
Sulfate, Total	13	mg/L	1	06/26/95	EPA 375.3	GMF		
Chloride(AutoFerricyanide)								
Chloride	5	mg/L	1	06/12/95	EPA 325.2	WOC		
Total Dissolved Solids								
Total Dissolved Solids	361	mg/L	5	06/05/95	EPA 160.1	RST		
Total Suspended Solids								
Total Suspended Solids	39	mg/L	5	06/06/95	EPA 160.2	RST		
Alkalinity, Total								
Alkalinity, Total	280	mg/L	1	06/06/95	EPA 310.1	MJW		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	9	mg/L	2.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	185	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	9
Aromatic Volatile Organics								
Benzene	610	ug/L	10	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	310	ug/L	10	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	440	ug/L	10	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	880	ug/L	25	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	126	%		06/14/95	EPA 8020	HMF	2164-17-2	

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60346665
Client Sample ID: E11-GW-TW1102
Date Collected: 06/01/95
Date Received: 06/02/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.01	mg/L	0.01	06/02/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/02/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	06/02/95	EPA 354.1	WOC		
Total Suspended Solids								
Total Suspended Solids	ND	mg/L	5	06/06/95	EPA 160.2	RST		
Fluoride								
Fluoride	0.2	mg/L	0.1	06/12/95	EPA 340.2	GMF	16984-48-8	
Sulfate, Total								
Sulfate, Total	382	mg/L	1	06/26/95	EPA 375.3	GMF		
Total Dissolved Solids								
Total Dissolved Solids	340	mg/L	5	06/05/95	EPA 160.1	RST		
Phosphorus, Total								
Phosphorus	0.25	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
alinity, Total								
inity, Total	270	mg/L	1	06/06/95	EPA 310.1	MJW		
C e(AutoFerricyanide)								
ide	5	mg/L	1	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	80	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	ND	ug/L	2	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	ND	ug/L	5	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	124	%		06/14/95	EPA 8020	HMF	2164-17-2	

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60348000	Date Collected:	06/02/95
Client Sample ID:	E11-GW-TW1104	Date Received:	06/03/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.01	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	342	mg/L	5	06/05/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	260	mg/L	1	06/06/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.25	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	38	mg/L	1	06/26/95	EPA 375.3	GMF		
Fluoride								
Fluoride	0.2	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	ND	mg/L	5	06/06/95	EPA 160.2	RST		
Chloride(AutoFerricyanide)								
Chloride	7	mg/L	1	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	16	mg/L	2.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	183	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	10
Aromatic Volatile Organics								
Benzene	130	ug/L	2	06/14/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	210	ug/L	2	06/14/95	EPA 8020	TAT	100-41-4	
Toluene	170	ug/L	2	06/14/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	560	ug/L	25	06/14/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	108	%		06/14/95	EPA 8020	TAT	2164-17-2	

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60348018
Client Sample ID: E11-GW-TW1106

Date Collected: 06/02/95
Date Received: 06/03/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.013	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.013	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	435	mg/L	5	06/05/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	430	mg/L	1	06/06/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.24	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	7	mg/L	1	06/26/95	EPA 375.3	GMF		
Fluoride								
Fluoride	0.3	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
[illegible]l Suspended Solids								
[illegible] Suspended Solids	9	mg/L	5	06/06/95	EPA 160.2	RST		
C[illegible]e(AutoFerricyanide)								
[illegible]ide	4	mg/L	1	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	126	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	ND	ug/L	2	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	ND	ug/L	5	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	120	%		06/14/95	EPA 8020	HMF	2164-17-2	

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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60350618 Date Collected: 06/05/95
Client Sample ID: E11-GW-TW1109 Date Received: 06/06/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.1	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.1	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	363	mg/L	5	06/12/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	330	mg/L	1	06/13/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	3.1	mg/L	0.25	06/21/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	22	mg/L	1	06/26/95	EPA 375.3	GMF		
Fluoride								
Fluoride	0.2	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	21	mg/L	5	06/06/95	EPA 160.2	RST		
Chloride(AutoFerricyanide)								
Chloride	36	mg/L	1	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	0.57	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	15.5	mg/L	2.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	217	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	12
Aromatic Volatile Organics								
Benzene	2200	ug/L	100	06/14/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	170	ug/L	10	06/14/95	EPA 8020	TAT	100-41-4	
Toluene	160	ug/L	10	06/14/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	1100	ug/L	25	06/14/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	116	%		06/14/95	EPA 8020	TAT	2164-17-2	

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REPORT OF LABORATORY ANALYSIS

DATE: 07/05/95
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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60348042	Date Collected:	06/02/95
Client Sample ID:	E11-GW-TW1110	Date Received:	06/03/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.06	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, Nitrate	0.06	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.12	mg/L	0.01	06/03/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	917	mg/L	5	06/05/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	350	mg/L	1	06/06/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	1.23	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	3	mg/L	1	06/26/95	EPA 375.3	GMF		
Fluoride								
Fluoride	0.3	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
[illegible]l Suspended Solids								
[illegible] Suspended Solids	43	mg/L	5	06/06/95	EPA 160.2	RST		
Ch[illegible] (AutoFerricyanide)								
[illegible]de	200	mg/L	2	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	1.21	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	52.5	mg/L	25	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	118	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	10000	ug/L	100	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	1000	ug/L	100	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	280	ug/L	100	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	3200	ug/L	250	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	120	%		06/14/95	EPA 8020	HMF	2164-17-2	

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REPORT OF LABORATORY ANALYSIS

Brown & Root Environmental
800 Oak Ridge Turnpike
Suite A-600
Oak Ridge, TN 37830

PACE Project Number: 605096
Client Project ID: Eaker AFB - 0114
SDG Number: BR5096

Attn: Mr. Allan Jenkins
Phone: 615-483-9900

PACE Sample No: 60354297
Client Sample ID: E11-GW-MW1121
Date Collected: 06/08/95
Date Received: 06/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Mercury, CVAAS								
Mercury	ND	ug/L	0.2	06/21/95	EPA 7470	TSP	7439-97-6	
Antimony, AAS Furnace								
Antimony	ND	ug/L	10	06/27/95	EPA 7041	JAH	7440-36-0	
Date Digested				06/21/95				
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/26/95	EPA 7421	TSP	7439-92-1	
Date Digested				06/21/95				
Arsenic, AAS Furnace								
Arsenic	ND	ug/L	5	06/26/95	EPA 7060	TSP	7440-38-2	
Date Digested				06/21/95				
Metals, ICP								
Aluminum	378	ug/L	75	07/06/95	EPA 6010	KVU	7429-90-5	
Barium	61.4	ug/L	4	07/06/95	EPA 6010	KVU	7440-39-3	
Beryllium	ND	ug/L	1	07/06/95	EPA 6010	KVU	7440-41-7	
Cadmium	ND	ug/L	5	07/06/95	EPA 6010	KVU	7440-43-9	
Calcium	12500	ug/L	100	07/06/95	EPA 6010	KVU	7440-70-2	
Chromium	ND	ug/L	7	07/06/95	EPA 6010	KVU	7440-47-3	
Cobalt	ND	ug/L	7	07/06/95	EPA 6010	KVU	7440-48-4	
Copper	ND	ug/L	10	07/06/95	EPA 6010	KVU	7440-50-8	
Iron	517	ug/L	40	07/06/95	EPA 6010	KVU	7439-89-6	
Magnesium	3980	ug/L	50	07/06/95	EPA 6010	KVU	7439-95-4	
Manganese	51.5	ug/L	7	07/06/95	EPA 6010	KVU	7439-96-5	
Molybdenum	ND	ug/L	20	07/06/95	EPA 6010	KVU	7439-98-7	
Nickel	ND	ug/L	30	07/06/95	EPA 6010	KVU	7440-02-0	
Potassium	1520	ug/L	1000	07/06/95	EPA 6010	KVU	7440-09-7	
Silver	ND	ug/L	7	07/06/95	EPA 6010	KVU	7440-22-4	
Sodium	6990	ug/L	150	07/06/95	EPA 6010	KVU	7440-23-5	
Vanadium	ND	ug/L	12	07/06/95	EPA 6010	KVU	7440-62-2	
Zinc	80.4	ug/L	20	07/06/95	EPA 6010	KVU	7440-66-6	

ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

DATE: 07/12/95
PAGE: 2

PACE Project Number: 605096
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60354297
Client Sample ID: E11-GW-MW1121

Date Collected: 06/08/95
Date Received: 06/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Date Digested				06/21/95				
Thallium, AAS Furnace								
Thallium	ND	ug/L	5	06/27/95	EPA 7841	KVU	7440-28-0	
Date Digested				06/21/95				
Selenium, AAS Furnace								
Selenium	7.2	ug/L	5	06/26/95	EPA 7740	KVU	7782-49-2	
Date Digested				06/21/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.02	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Nitrogen, Nitrate	0.11	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.13	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	101	mg/L	5	06/12/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	62	mg/L	1	06/14/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	1.09	mg/L	0.05	07/06/95	EPA 365.2	GMF	7723-14-0	
[illegible]fate, Total								
[illegible]lfate, Total	15	mg/L	1	07/11/95	EPA 375.3	MJW		1
[illegible]de								
[illegible]de	ND	mg/L	0.1	06/26/95	EPA 340.2	GMF	16984-48-8	
To[illegible]spended Solids								
Total Suspended Solids	20	mg/L	5	06/12/95	EPA 160.2	RST		
Chloride(AutoFerricyanide)								
Chloride	ND	mg/L	1	06/30/95	EPA 325.2	WOC		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/16/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	108	%		06/16/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/16/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/16/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/L	2	06/16/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/L	5	06/16/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	112	%		06/16/95	EPA 8020	TAT	2164-17-2	
GC								
TPH, Water, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/L	0.4	06/16/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/L	0.4	06/16/95	EPA Mod 8015 ext	EMA		

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REPORT OF LABORATORY ANALYSIS

PACE Project Number: 605096
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60354297 | Date Collected: 06/08/95
Client Sample ID: E11-GW-MW1121 | Date Received: 06/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Jet Fuel	ND	mg/L	0.4	06/16/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/L	0.4	06/16/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/L	0.4	06/16/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/L	0.4	06/16/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/L	0.4	06/16/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/L	0.4	06/16/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	83	%		06/16/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	80	%		06/16/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				06/12/95				
GC/MS -- Semi-VOA								
Semivolatile Organics								
Phenol	ND	ug/L	10	06/19/95	EPA 8270	MSR	108-95-2	
bis(2-Chloroethyl)ether	ND	ug/L	10	06/19/95	EPA 8270	MSR	111-44-4	
2-Chlorophenol	ND	ug/L	10	06/19/95	EPA 8270	MSR	95-57-8	
1,3-Dichlorobenzene	ND	ug/L	10	06/19/95	EPA 8270	MSR	541-73-1	
1,4-Dichlorobenzene	ND	ug/L	10	06/19/95	EPA 8270	MSR	106-46-7	
Benzyl Alcohol	ND	ug/L	20	06/19/95	EPA 8270	MSR	100-51-6	
1,2-Dichlorobenzene	ND	ug/L	10	06/19/95	EPA 8270	MSR	95-50-1	
2-Methylphenol	ND	ug/L	10	06/19/95	EPA 8270	MSR	95-48-7	
bis(2-Chloroisopropyl)ether	ND	ug/L	10	06/19/95	EPA 8270	MSR	108-60-1	
4-Methylphenol	ND	ug/L	10	06/19/95	EPA 8270	MSR	106-44-5	
N-Nitroso-di-n-propylamine	ND	ug/L	10	06/19/95	EPA 8270	MSR	621-64-7	
Hexachloroethane	ND	ug/L	10	06/19/95	EPA 8270	MSR	67-72-1	
Nitrobenzene	ND	ug/L	10	06/19/95	EPA 8270	MSR	98-95-3	
Isophorone	ND	ug/L	10	06/19/95	EPA 8270	MSR	78-59-1	
2-Nitrophenol	ND	ug/L	10	06/19/95	EPA 8270	MSR	88-75-5	
2,4-Dimethylphenol	ND	ug/L	10	06/19/95	EPA 8270	MSR	105-67-9	
Benzoic Acid	ND	ug/L	50	06/19/95	EPA 8270	MSR	65-85-0	
bis(2-Chloroethoxy)methane	ND	ug/L	10	06/19/95	EPA 8270	MSR	111-91-1	
2,4-Dichlorophenol	ND	ug/L	10	06/19/95	EPA 8270	MSR	120-83-2	
1,2,4-Trichlorobenzene	ND	ug/L	10	06/19/95	EPA 8270	MSR	120-82-1	
Naphthalene	ND	ug/L	10	06/19/95	EPA 8270	MSR	91-20-3	
4-Chloroaniline	ND	ug/L	20	06/19/95	EPA 8270	MSR	106-47-8	
Hexachlorobutadiene	ND	ug/L	10	06/19/95	EPA 8270	MSR	87-68-3	
4-Chloro-3-methylphenol	ND	ug/L	20	06/19/95	EPA 8270	MSR	59-50-7	
2-Methylnaphthalene	ND	ug/L	10	06/19/95	EPA 8270	MSR	91-57-6	
Hexachlorocyclopentadiene	ND	ug/L	10	06/19/95	EPA 8270	MSR	77-47-4	
2,4,6-Trichlorophenol	ND	ug/L	10	06/19/95	EPA 8270	MSR	88-06-2	
2,4,5-Trichlorophenol	ND	ug/L	50	06/19/95	EPA 8270	MSR	95-95-4	
2-Chloronaphthalene	ND	ug/L	10	06/19/95	EPA 8270	MSR	91-58-7	

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REPORT OF LABORATORY ANALYSIS

DATE: 07/12/95

PACE Project Number: 605096
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60354297
Client Sample ID: E11-GW-MW1121

Date Collected: 06/08/95
Date Received: 06/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
2-Nitroaniline	ND	ug/L	50	06/19/95	EPA 8270	MSR	88-74-4	
Dimethylphthalate	ND	ug/L	10	06/19/95	EPA 8270	MSR	131-11-3	
Acenaphthylene	ND	ug/L	10	06/19/95	EPA 8270	MSR	208-96-8	
2,6-Dinitrotoluene	ND	ug/L	10	06/19/95	EPA 8270	MSR	606-20-2	
3-Nitroaniline	ND	ug/L	50	06/19/95	EPA 8270	MSR	99-09-2	
Acenaphthene	ND	ug/L	10	06/19/95	EPA 8270	MSR	83-32-9	
2,4-Dinitrophenol	ND	ug/L	50	06/19/95	EPA 8270	MSR	51-28-5	
4-Nitrophenol	ND	ug/L	50	06/19/95	EPA 8270	MSR	100-02-7	
Dibenzofuran	ND	ug/L	10	06/19/95	EPA 8270	MSR	132-64-9	
2,4-Dinitrotoluene	ND	ug/L	10	06/19/95	EPA 8270	MSR	121-14-2	
Diethylphthalate	ND	ug/L	10	06/19/95	EPA 8270	MSR	84-66-2	
4-Chlorophenyl-phenylether	ND	ug/L	10	06/19/95	EPA 8270	MSR	7005-72-3	
Fluorene	ND	ug/L	10	06/19/95	EPA 8270	MSR	86-73-7	
4-Nitroaniline	ND	ug/L	50	06/19/95	EPA 8270	MSR	100-01-6	
' 6-Dinitro-2-methylphenol	ND	ug/L	50	06/19/95	EPA 8270	MSR	534-52-1	
Nitrosodiphenylamine	ND	ug/L	10	06/19/95	EPA 8270	MSR	86-30-6	
ophenyl-phenylether	ND	ug/L	10	06/19/95	EPA 8270	MSR	101-55-3	
lorobenzene	ND	ug/L	10	06/19/95	EPA 8270	MSR	118-74-1	
Pentachlorophenol	ND	ug/L	50	06/19/95	EPA 8270	MSR	87-86-5	
Phenanthrene	ND	ug/L	10	06/19/95	EPA 8270	MSR	85-01-8	
Anthracene	ND	ug/L	10	06/19/95	EPA 8270	MSR	120-12-7	
Di-n-butylphthalate	ND	ug/L	10	06/19/95	EPA 8270	MSR	84-74-2	
Fluoranthene	ND	ug/L	10	06/19/95	EPA 8270	MSR	206-44-0	
Pyrene	ND	ug/L	10	06/19/95	EPA 8270	MSR	129-00-0	
Butylbenzylphthalate	ND	ug/L	10	06/19/95	EPA 8270	MSR	85-68-7	
3,3'-Dichlorobenzidine	ND	ug/L	20	06/19/95	EPA 8270	MSR	91-94-1	
Benzo(a)anthracene	ND	ug/L	10	06/19/95	EPA 8270	MSR	56-55-3	
Chrysene	ND	ug/L	10	06/19/95	EPA 8270	MSR	218-01-9	
bis(2-Ethylhexyl)phthalate	ND	ug/L	10	06/19/95	EPA 8270	MSR	117-81-7	
Di-n-octylphthalate	ND	ug/L	10	06/19/95	EPA 8270	MSR	117-84-0	
Benzo(b)fluoranthene	ND	ug/L	10	06/19/95	EPA 8270	MSR	205-99-2	
Benzo(k)fluoranthene	ND	ug/L	10	06/19/95	EPA 8270	MSR	207-08-9	
Benzo(a)pyrene	ND	ug/L	10	06/19/95	EPA 8270	MSR	50-32-8	
Indeno(1,2,3-cd)pyrene	ND	ug/L	10	06/19/95	EPA 8270	MSR	193-39-5	
Dibenz(a,h)anthracene	ND	ug/L	10	06/19/95	EPA 8270	MSR	53-70-3	
Benzo(g,h,i)perylene	ND	ug/L	10	06/19/95	EPA 8270	MSR	191-24-2	
Nitrobenzene-d5 (S)	70	%		06/19/95	EPA 8270	MSR	4165-60-0	
2-Fluorobiphenyl (S)	53	%		06/19/95	EPA 8270	MSR	321-60-8	
Terphenyl-d14 (S)	65	%		06/19/95	EPA 8270	MSR	1718-51-0	
Phenol-d5 (S)	27	%		06/19/95	EPA 8270	MSR	13127-88-3	

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REPORT OF LABORATORY ANALYSIS

PACE Project Number: 605096
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60354297 Date Collected: 06/08/95
Client Sample ID: E11-GW-MW1121 Date Received: 06/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
2-Fluorophenol (S)	39	%		06/19/95	EPA 8270	MSR	367-12-4	
2,4,6-Tribromophenol (S)	59	%		06/19/95	EPA 8270	MSR	118-79-6	
Date Extracted				06/12/95				

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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

DATE: 09/12/95
PAGE: 86

PACE Project Number: 605941
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60433109 Date Collected: 08/15/95
Client Sample ID: E11-GW-MW111 Date Received: 08/16/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	08/31/95	EPA 7421	SMS	7439-92-1	
Date Digested				08/17/95				
Wet Chemistry								
Chloride(AutoFerricyanide)								
Chloride	1	mg/L	1	08/17/95	EPA 325.2	WOC		
Total Dissolved Solids								
Total Dissolved Solids	206	mg/L	5	08/18/95	EPA 160.1	MJW		
Alkalinity, Total								
Alkalinity, Total	170	mg/L	1	08/23/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.97	mg/L	0.05	08/30/95	EPA 365.2	EAH	7723-14-0	
Sulfate, Total								
Sulfate, Total	1	mg/L	1	08/31/95	EPA 375.3	EAH		
Fluoride								
Fluoride	0.2	mg/L	0.1	09/01/95	EPA 340.2	EAH	16984-48-8	
Total Suspended Solids								
tal Suspended Solids	6	mg/L	5	08/18/95	EPA 160.2	MJW		
ogen, Nitrite								
gen, Nitrite	0.1	mg/L	0.01	08/17/95	EPA 354.1	WOC		
en, Nitrate	ND	mg/L	0.01	08/17/95	EPA 354.1	WOC		
gen, NO2 plus NO3, Water	ND	mg/L	0.01	08/17/95	EPA 354.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	67	mg/L	2.5	08/24/95	EPA Mod 8015 pur	DJM		
a,a,a-Trifluorotoluene (S)	112	%		08/24/95	EPA Mod 8015 pur	DJM	2164-17-2	
Aromatic Volatile Organics								
Benzene	4100	ug/L	100	08/23/95	EPA 8020	DJM	71-43-2	
Ethyl Benzene	2000	ug/L	100	08/23/95	EPA 8020	DJM	100-41-4	
Toluene	11000	ug/L	100	08/23/95	EPA 8020	DJM	108-88-3	
Xylene (Total)	14000	ug/L	250	08/23/95	EPA 8020	DJM	1330-20-7	
a,a,a-Trifluorotoluene (S)	119	%		08/23/95	EPA 8020	DJM	2164-17-2	

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PACE Project Number: 605096
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60354305 Date Collected: 06/08/95
Client Sample ID: E11-GW-MW1111 Date Received: 06/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/26/95	EPA 7421	TSP	7439-92-1	
Date Digested				06/21/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.02	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Nitrogen, Nitrate	0.01	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.03	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Alkalinity, Total								
Alkalinity, Total	220	mg/L	1	06/14/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	1.16	mg/L	0.05	07/06/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	ND	mg/L	1	07/11/95	EPA 375.3	MJW		2
Fluoride								
Fluoride	0.2	mg/L	0.1	06/26/95	EPA 340.2	GMF	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	17	mg/L	5	06/12/95	EPA 160.2	RST		
Chloride(AutoFerricyanide)								
Chloride	ND	mg/L	1	06/30/95	EPA 325.2	WOC		
Total Dissolved Solids								
Total Dissolved Solids	214	mg/L	5	06/12/95	EPA 160.1	RST		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	21.2	mg/L	0.5	06/16/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	413	%		06/16/95	EPA Mod 8015 pur	TAT	2164-17-2	3
Aromatic Volatile Organics								
Benzene	5000	ug/L	100	06/16/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	2800	ug/L	100	06/16/95	EPA 8020	TAT	100-41-4	
Toluene	14000	ug/L	100	06/16/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	15000	ug/L	250	06/16/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	126	%		06/16/95	EPA 8020	TAT	2164-17-2	

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60350584 Date Collected: 06/05/95
Client Sample ID: E11-GW-MW1114 Date Received: 06/06/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	11.7	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.2	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	225	mg/L	5	06/12/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	83	mg/L	1	06/13/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.19	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	102	mg/L	1	06/26/95	EPA 375.3	GMF		
Fluoride								
luoride	0.2	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
Suspended Solids								
Suspended Solids	827	mg/L	5	06/06/95	EPA 160.2	RST		
e(AutoFerricyanide)								
oride	24	mg/L	1	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	5.09	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	129	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	ND	ug/L	2	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	ND	ug/L	5	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	115	%		06/14/95	EPA 8020	HMF	2164-17-2	

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60350592	Date Collected:	06/05/95
Client Sample ID:	E11-GW-MW1115	Date Received:	06/06/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.18	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.16	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	200	mg/L	5	06/12/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	81	mg/L	1	06/13/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.19	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	57	mg/L	1	06/26/95	EPA 375.3	GMF		
Fluoride								
Fluoride	0.2	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	81	mg/L	5	06/06/95	EPA 160.2	RST		
Chloride(AutoFerricyanide)								
Chloride	9	mg/L	1	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	0.82	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	149	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	11
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/14/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/14/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/L	2	06/14/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/L	5	06/14/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	111	%		06/14/95	EPA 8020	TAT	2164-17-2	

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60350600 Date Collected: 06/05/95
Client Sample ID: E11-GW-MW1116 Date Received: 06/06/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.02	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.02	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Total Dissolved Solids								
Total Dissolved Solids	189	mg/L	5	06/12/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	120	mg/L	1	06/13/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.19	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	52	mg/L	1	06/26/95	EPA 375.3	GMF		
Fluoride								
Fluoride	0.3	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	ND	mg/L	5	06/06/95	EPA 160.2	RST		
Chloride(AutoFerricyanide)								
Chloride	3	mg/L	1	06/12/95	EPA 325.2	WOC		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	129	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	ND	ug/L	2	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	ND	ug/L	5	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	119	%		06/14/95	EPA 8020	HMF	2164-17-2	

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PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60350626 Date Collected: 06/05/95
Client Sample ID: E11-GW-MW1119 Date Received: 06/06/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/23/95	EPA 7421	KVU	7439-92-1	
Date Digested				06/12/95				
Wet Chemistry								
Chloride(AutoFerricyanide)								
Chloride	9	mg/L	1	06/12/95	EPA 325.2	WOC		
Phosphorus, Total								
Phosphorus	0.48	mg/L	0.05	06/21/95	EPA 365.2	GMF	7723-14-0	
Total Dissolved Solids								
Total Dissolved Solids	717	mg/L	5	06/12/95	EPA 160.1	RST		
Alkalinity, Total								
Alkalinity, Total	630	mg/L	1	06/13/95	EPA 310.1	MJW		
Fluoride								
Fluoride	0.3	mg/L	0.1	06/16/95	EPA 340.2	GMF	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	20	mg/L	5	06/06/95	EPA 160.2	RST		
Sulfate, Total								
Sulfate, Total	86	mg/L	1	06/26/95	EPA 375.3	GMF		
Nitrogen, Nitrite								
Nitrogen, Nitrite	0.02	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	0.01	mg/L	0.01	06/06/95	EPA 354.1	WOC		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/14/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	126	%		06/14/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	ND	ug/L	2	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	ND	ug/L	5	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	127	%		06/14/95	EPA 8020	HMF	2164-17-2	

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PACE Project Number: 605096
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60354313
Client Sample ID: E11-GW-MW1120
Date Collected: 06/08/95
Date Received: 06/09/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	ND	ug/L	5	06/26/95	EPA 7421	TSP	7439-92-1	
Date Digested				06/21/95				
Wet Chemistry								
Nitrogen, Nitrite								
Nitrogen, Nitrite	ND	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Nitrogen, Nitrate	ND	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Nitrogen, NO2 plus NO3, Water	ND	mg/L	0.01	06/09/95	EPA 354.1	WOC		
Alkalinity, Total								
Alkalinity, Total	240	mg/L	1	06/14/95	EPA 310.1	MJW		
Phosphorus, Total								
Phosphorus	0.74	mg/L	0.05	07/06/95	EPA 365.2	GMF	7723-14-0	
Sulfate, Total								
Sulfate, Total	2.5	mg/L	1	07/11/95	EPA 375.3	MJW		4
Fluoride								
Fluoride	0.2	mg/L	0.1	06/26/95	EPA 340.2	GMF	16984-48-8	
Total Suspended Solids								
Total Suspended Solids	8	mg/L	5	06/12/95	EPA 160.2	RST		
Chloride(AutoFerricyanide)								
Chloride	ND	mg/L	1	06/30/95	EPA 325.2	WOC		
Total Dissolved Solids								
Total Dissolved Solids	246	mg/L	5	06/12/95	EPA 160.1	RST		
Bromide								
Bromide	ND	mg/L	0.5	06/13/95	EPA 320.1	WOC		
GC -- Volatiles								
TPH, Water, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/L	0.5	06/16/95	EPA Mod 8015 pur	TAT		
a,a,a-Trifluorotoluene (S)	121	%		06/16/95	EPA Mod 8015 pur	TAT	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/16/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/16/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/L	2	06/16/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/L	5	06/16/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	100	%		06/16/95	EPA 8020	TAT	2164-17-2	

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PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60286259 Date Collected: 04/08/95
Client Sample ID: E11-SU-MW1121A Date Received: 04/11/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Mercury, CVAAS								
Mercury	0.123	mg/kg	0.12	04/28/95	EPA 7471	MHT	7439-97-6	
Arsenic, AAS Furnace								
Arsenic	9.23	mg/kg	1.2	04/25/95	EPA 7060	JAH	7440-38-2	
Date Digested				04/21/95				
Lead, AAS Furnace								
Lead	11.4	mg/kg	1.2	04/26/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/21/95				
Antimony, AAS Furnace								
Antimony	ND	mg/kg	1.2	04/28/95	EPA 7041	JAH	7440-36-0	
Date Digested				04/21/95				
Thallium, AAS Furnace								
Thallium	ND	mg/kg	0.598	04/28/95	EPA 7841	MHT	7440-28-0	
Date Digested				04/21/95				
Metals, ICP								
Aluminum	3010	mg/kg	8.97	04/25/95	EPA 6010	JAH	7429-90-5	
Barium	43.2	mg/kg	0.478	04/25/95	EPA 6010	JAH	7440-39-3	
Beryllium	0.307	mg/kg	0.12	04/25/95	EPA 6010	JAH	7440-41-7	
Cadmium	ND	mg/kg	0.598	04/25/95	EPA 6010	JAH	7440-43-9	
Calcium	1820	mg/kg	12	04/25/95	EPA 6010	JAH	7440-70-2	
Chromium	8.74	mg/kg	0.837	04/25/95	EPA 6010	JAH	7440-47-3	
Cobalt	9.03	mg/kg	0.837	04/25/95	EPA 6010	JAH	7440-48-4	
Copper	31.6	mg/kg	1.2	04/25/95	EPA 6010	JAH	7440-50-8	
Iron	6130	mg/kg	4.78	04/25/95	EPA 6010	JAH	7439-89-6	
Magnesium	983	mg/kg	5.98	04/25/95	EPA 6010	JAH	7439-95-4	
Manganese	88.7	mg/kg	0.837	04/25/95	EPA 6010	JAH	7439-96-5	
Molybdenum	ND	mg/kg	2.39	04/25/95	EPA 6010	JAH	7439-98-7	
Nickel	36.5	mg/kg	3.59	04/25/95	EPA 6010	JAH	7440-02-0	
Potassium	379	mg/kg	120	04/25/95	EPA 6010	JAH	7440-09-7	
Silver	ND	mg/kg	0.837	04/25/95	EPA 6010	JAH	7440-22-4	
Sodium	62.1	mg/kg	17.9	04/25/95	EPA 6010	JAH	7440-23-5	
Vanadium	31.1	mg/kg	1.43	04/25/95	EPA 6010	JAH	7440-62-2	
Zinc	44.7	mg/kg	2.39	04/25/95	EPA 6010	JAH	7440-66-6	
Date Digested				04/21/95				
Selenium, AAS Furnace								
Selenium	0.658	mg/kg	0.598	05/02/95	EPA 7740	JAH	7782-49-2	
Date Digested				04/21/95				
Wet Chemistry								
Nitrogen, Nitrate plus Nitrite								

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PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60286259 Date Collected: 04/08/95
Client Sample ID: E11-SU-MW1121A Date Received: 04/11/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Nitrogen, NO2 plus NO3, Soil	2.39	mg/kg	1.2	04/26/95	EPA 353.2	WOC		
Total Organic Carbon in Soil								
Total Organic Carbon	ND	mg/kg	20	04/24/95	ASA 90-3	KEZ	7440-44-0	3
Microbiological Test Solid								
Standard Plate Count	280	col/g	1	04/19/95	Standard Methods	WOC		
Date Prepared				04/19/95 10				
Phosphorus, Total, Soil								
Phosphorus	973	mg/kg	119	05/05/95	EPA 365.2 Modified	GMF	7723-14-0	
Organics								
Moisture								
Percent Moisture	16.4	%		04/12/95		GCZ		
GC -- Volatiles								
TPH, Soil, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/kg	6	04/19/95	EPA Mod 8015 ext	HMF		
.a-Trifluorotoluene (S)	90	%		04/19/95	EPA Mod 8015 ext	HMF	2164-17-2	
A[illegible] Volatile Organics								
[illegible]e	ND	ug/kg	2.3	04/20/95	EPA 8020	TAT	71-43-2	
Et[illegible] Benzene	ND	ug/kg	2.3	04/20/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/kg	2.3	04/20/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/kg	5.8	04/20/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	119	%		04/20/95	EPA 8020	TAT	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	100	%		04/16/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	92	%		04/16/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				
GC/MS -- Semi-VOA								
Semivolatile Organics								
Phenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	108-95-2	
bis(2-Chloroethyl)ether	ND	ug/kg	330	04/21/95	EPA 8270	MSR	111-44-4	
2-Chlorophenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	95-57-8	
[illegible]3-Dichlorobenzene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	541-73-1	

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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60286259 Date Collected: 04/08/95
Client Sample ID: E11-SU-MW1121A Date Received: 04/11/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
1,4-Dichlorobenzene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	106-46-7	
Benzyl Alcohol	ND	ug/kg	650	04/21/95	EPA 8270	MSR	100-51-6	
1,2-Dichlorobenzene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	95-50-1	
2-Methylphenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	95-48-7	
bis(2-Chloroisopropyl)ether	ND	ug/kg	330	04/21/95	EPA 8270	MSR	39638-32-9	
4-Methylphenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	106-44-5	
N-Nitroso-di-n-propylamine	ND	ug/kg	330	04/21/95	EPA 8270	MSR	621-64-7	
Hexachloroethane	ND	ug/kg	330	04/21/95	EPA 8270	MSR	67-72-1	
Nitrobenzene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	98-95-3	
Isophorone	ND	ug/kg	330	04/21/95	EPA 8270	MSR	78-59-1	
2-Nitrophenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	88-75-5	
2,4-Dimethylphenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	105-67-9	
Benzoic Acid	ND	ug/kg	1600	04/21/95	EPA 8270	MSR	65-85-0	
bis(2-Chloroethoxy)methane	ND	ug/kg	330	04/21/95	EPA 8270	MSR	111-91-1	
2,4-Dichlorophenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	120-83-2	
1,2,4-Trichlorobenzene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	120-82-1	
Naphthalene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	91-20-3	
4-Chloroaniline	ND	ug/kg	650	04/21/95	EPA 8270	MSR	106-47-8	
Hexachlorobutadiene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	87-68-3	
4-Chloro-3-methylphenol	ND	ug/kg	650	04/21/95	EPA 8270	MSR	59-50-7	
2-Methylnaphthalene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	91-57-6	
Hexachlorocyclopentadiene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	77-47-4	
2,4,6-Trichlorophenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	88-06-2	
2,4,5-Trichlorophenol	ND	ug/kg	330	04/21/95	EPA 8270	MSR	95-95-4	
2-Chloronaphthalene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	91-58-7	
2-Nitroaniline	ND	ug/kg	1600	04/21/95	EPA 8270	MSR	88-74-4	
Dimethylphthalate	ND	ug/kg	330	04/21/95	EPA 8270	MSR	131-11-3	
Acenaphthylene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	208-96-8	
2,6-Dinitrotoluene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	606-20-2	
3-Nitroaniline	ND	ug/kg	1600	04/21/95	EPA 8270	MSR	99-09-2	
Acenaphthene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	83-32-9	
2,4-Dinitrophenol	ND	ug/kg	1600	04/21/95	EPA 8270	MSR	51-28-5	
4-Nitrophenol	ND	ug/kg	1600	04/21/95	EPA 8270	MSR	100-02-7	
Dibenzofuran	ND	ug/kg	330	04/21/95	EPA 8270	MSR	132-64-9	
2,4-Dinitrotoluene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	121-14-2	
Diethylphthalate	ND	ug/kg	330	04/21/95	EPA 8270	MSR	84-66-2	
4-Chlorophenyl-phenylether	ND	ug/kg	330	04/21/95	EPA 8270	MSR	7005-72-3	
Fluorene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	86-73-7	
4-Nitroaniline	ND	ug/kg	1600	04/21/95	EPA 8270	MSR	100-01-6	
4,6-Dinitro-2-methylphenol	ND	ug/kg	1600	04/21/95	EPA 8270	MSR	534-52-1	

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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

DATE: 05/09/95

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60286259	Date Collected:	04/08/95
Client Sample ID:	E11-SU-MW1121A	Date Received:	04/11/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
N-Nitrosodiphenylamine	ND	ug/kg	330	04/21/95	EPA 8270	MSR	86-30-6	
4-Bromophenyl-phenylether	ND	ug/kg	330	04/21/95	EPA 8270	MSR	101-55-3	
Hexachlorobenzene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	118-74-1	
Pentachlorophenol	ND	ug/kg	1600	04/21/95	EPA 8270	MSR	87-86-5	
Phenanthrene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	85-01-8	
Anthracene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	120-12-7	
Di-n-butylphthalate	ND	ug/kg	330	04/21/95	EPA 8270	MSR	84-74-2	
Fluoranthene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	206-44-0	
Pyrene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	129-00-0	
Butylbenzylphthalate	ND	ug/kg	330	04/21/95	EPA 8270	MSR	85-68-7	
3,3'-Dichlorobenzidine	ND	ug/kg	650	04/21/95	EPA 8270	MSR	91-94-1	
Benzo(a)anthracene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	56-55-3	
Chrysene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	218-01-9	
bis(2-Ethylhexyl)phthalate	360	ug/kg	330	04/21/95	EPA 8270	MSR	117-81-7	
[illegible]-n-octylphthalate	ND	ug/kg	330	04/21/95	EPA 8270	MSR	117-84-0	
[illegible]o(b)fluoranthene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	205-99-2	
[illegible]k)fluoranthene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	207-08-9	
[illegible](a)pyrene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	50-32-8	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	193-39-5	
Dibenz(a,h)anthracene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	53-70-3	
Benzo(g,h,i)perylene	ND	ug/kg	330	04/21/95	EPA 8270	MSR	191-24-2	
Nitrobenzene-d5 (S)	61	%		04/21/95	EPA 8270	MSR	4165-60-0	
2-Fluorobiphenyl (S)	68	%		04/21/95	EPA 8270	MSR	321-60-8	
Terphenyl-d14 (S)	78	%		04/21/95	EPA 8270	MSR	1718-51-0	
Phenol-d5 (S)	62	%		04/21/95	EPA 8270	MSR	13127-88-3	
2-Fluorophenol (S)	84	%		04/21/95	EPA 8270	MSR	367-12-4	
2,4,6-Tribromophenol (S)	106	%		04/21/95	EPA 8270	MSR	118-79-6	
Date Extracted				04/14/95				

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REPORT OF LABORATORY ANALYSIS

April 24, 1995
Report No.: 000402[illegible]
Section A Page 1

LABORATORY ANALYSIS REPORT

CLIENT NAME: PACE INCORPORATED-KANSAS
ADDRESS: 9608 LOIRET BOULEVARD
LENEXA, KS 66219-
ATTENTION: CHRISTINA SCHARFF

SAMPLE ID: 60286259
SAMPLE NO: H296300

LIMS CLIENT: 0719 0613
PACE PROJECT: 604183
PACE CLIENT: 000560
P.O. NO: VERBAL

DATE SAMPLED: 08-APR-95 0832
DATE RECEIVED: 14-APR-95
PROJECT MANAGER: Debbie Proctor

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	I107S	Carbon, Total Organic (C)	0.33	%

COMMENTS: Results are reported on an "as received" basis without correction for percent moisture unless previously specified.

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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

DATE: 09/18/95
PAGE: 27

PACE Project Number: 605945
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60430584 Date Collected: 08/11/95
Client Sample ID: E11-SU-MW1123A Date Received: 08/15/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	6.41	mg/kg	0.61	08/30/95	EPA 7421	JAH	7439-92-1	
Date Digested				08/23/95				
Organics								
Moisture								
Percent Moisture	18.1	%		08/21/95		KMN		
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	ND	ug/kg	61	08/24/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	ND	ug/kg	61	08/24/95	EPA 8020	HMF	100-41-4	
Toluene	ND	ug/kg	61	08/24/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	ND	ug/kg	150	08/24/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	70	%		08/24/95	EPA 8020	HMF	2164-17-2	
Soil, Purge by Mod. 8015								
[illegible] Petroleum Hydrocarbons	ND	mg/kg	6.1	08/23/95	EPA Mod 8015 pur	MAG		
[illegible]Trifluorotoluene (S)	116	%		08/23/95	EPA Mod 8015 pur	MAG	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4	08/26/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	4	08/26/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4	08/26/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4	08/26/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4	08/26/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4	08/26/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4	08/26/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	4	08/26/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	53	%		08/26/95	EPA Mod 8015 ext	EMA	117-84-0	4
n-Tetracosane (S)	71	%		08/26/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				08/23/95				

PACE INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60283470	Date Collected:	04/07/95
Client Sample ID:	E11-SU-MW1122A	Date Received:	04/08/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	17.9	mg/kg	1.26	04/26/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/21/95				
Organics								
Moisture								
Percent Moisture	20.5	%		04/11/95		KMN		
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	3.3	ug/kg	2.5	04/20/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/kg	2.5	04/20/95	EPA 8020	TAT	100-41-4	
Toluene	4	ug/kg	2.5	04/20/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/kg	6.2	04/20/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	132	%		04/20/95	EPA 8020	TAT	2164-17-2	
TPH, Soil, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/kg	6.2	04/19/95	EPA Mod 8015 ext	HMF		
a,a,a-Trifluorotoluene (S)	83	%		04/19/95	EPA Mod 8015 ext	HMF	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	88	%		04/15/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	83	%		04/15/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

DATE: 05/05/95
PAGE: 80

PACE Project Number: 604134
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60282811 | Date Collected: 04/06/95
Client Sample ID: E11-SU-SB1129A | Date Received: 04/07/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	7.9	mg/kg	0.613	04/20/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/10/95				
Organics								
Moisture								
Percent Moisture	17.6	%		04/11/95		KMN		
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	ND	ug/kg	2.4	04/18/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/kg	2.4	04/18/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/kg	2.4	04/18/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/kg	6	04/18/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	126	%		04/18/95	EPA 8020	TAT	2164-17-2	
Soil, Purge by Mod. 8015								
...l Petroleum Hydrocarbons	ND	mg/kg	6.1	04/18/95	EPA Mod 8015 ext	HMF		
...rifluorotoluene (S)	93	%		04/18/95	EPA Mod 8015 ext	HMF	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	4	04/16/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	94	%		04/16/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	87	%		04/16/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

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PACE INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

DATE: 05/05/95
PAGE: 81

PACE Project Number: 604134
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60282829 Date Collected: 04/06/95
Client Sample ID: E11-SU-SB1130A Date Received: 04/07/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	13.2	mg/kg	1.9	04/20/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/10/95				
Organics								
Moisture								
Percent Moisture	21.9	%		04/11/95		KMN		
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	ND	ug/kg	2.5	04/18/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/kg	2.5	04/18/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/kg	2.5	04/18/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/kg	6.2	04/18/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	124	%		04/18/95	EPA 8020	TAT	2164-17-2	
TPH, Soil, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/kg	6.3	04/18/95	EPA Mod 8015 ext	HMF		
a,a,a-Trifluorotoluene (S)	73	%		04/18/95	EPA Mod 8015 ext	HMF	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4.2	04/16/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	4.2	04/16/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4.2	04/16/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4.2	04/16/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4.2	04/16/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4.2	04/16/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4.2	04/16/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	4.2	04/16/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	96	%		04/16/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	90	%		04/16/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60283462 Date Collected: 04/07/95
Client Sample ID: E11-SU-SB1131A Date Received: 04/08/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	12.2	mg/kg	1.26	04/26/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/21/95				
Organics								
Moisture								
Percent Moisture	20.8	%		04/11/95		KMN		
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	5.8	ug/kg	2.5	04/20/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/kg	2.5	04/20/95	EPA 8020	TAT	100-41-4	
Toluene	7.6	ug/kg	2.5	04/20/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/kg	6.2	04/20/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	121	%		04/20/95	EPA 8020	TAT	2164-17-2	
T[illegible] Soil, Purge by Mod. 8015								
[illegible]l Petroleum Hydrocarbons	ND	mg/kg	6.3	04/19/95	EPA Mod 8015 ext	HMF		
a[illegible]rifluorotoluene (S)	80	%		04/19/95	EPA Mod 8015 ext	HMF	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	102	%		04/15/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	94	%		04/15/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

PACE INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60286333	Date Collected:	04/09/95
Client Sample ID:	E11-SU-SB1132A	Date Received:	04/11/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	10.6	mg/kg	0.617	04/26/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/21/95				
Organics								
Moisture								
Percent Moisture	19.0	%		04/12/95		GCZ		
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	ND	ug/kg	2.5	04/20/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/kg	2.5	04/20/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/kg	2.5	04/20/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/kg	6.2	04/20/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	127	%		04/20/95	EPA 8020	TAT	2164-17-2	
TPH, Soil, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/kg	6.2	04/19/95	EPA Mod 8015 ext	HMF		
a,a,a-Trifluorotoluene (S)	77	%		04/19/95	EPA Mod 8015 ext	HMF	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4.1	04/16/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	4.1	04/16/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4.1	04/16/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4.1	04/16/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4.1	04/16/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4.1	04/16/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4.1	04/16/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	4.1	04/16/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	97	%		04/16/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	92	%		04/16/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60283454	Date Collected:	04/07/95
Client Sample ID:	E11-SU-SB1133A	Date Received:	04/08/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	12.1	mg/kg	1.84	04/26/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/21/95				
Organics								
Moisture								
Percent Moisture	18.4	%		04/11/95		KMN		
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	ND	ug/kg	2.4	04/20/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/kg	2.4	04/20/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/kg	2.4	04/20/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/kg	6.1	04/20/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	123	%		04/20/95	EPA 8020	TAT	2164-17-2	
Soil, Purge by Mod. 8015								
tal Petroleum Hydrocarbons	ND	mg/kg	6.1	04/19/95	EPA Mod 8015 ext	HMF		
rifluorotoluene (S)	77	%		04/19/95	EPA Mod 8015 ext	HMF	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	4.1	04/15/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	103	%		04/15/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	95	%		04/15/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

PACE INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

DATE: 05/09/95

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60286267 Date Collected: 04/08/95
Client Sample ID: E11-SU-SB1134A Date Received: 04/11/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	21.2	mg/kg	1.77	04/26/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/21/95				
Organics								
Moisture								
Percent Moisture	15.1	%		04/12/95		GCZ		
GC -- Volatiles								
TPH, Soil, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	ND	mg/kg	5.9	04/19/95	EPA Mod 8015 ext	HMF		
a,a,a-Trifluorotoluene (S)	87	%		04/19/95	EPA Mod 8015 ext	HMF	2164-17-2	
Aromatic Volatile Organics								
Benzene	ND	ug/kg	2.3	04/20/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	ND	ug/kg	2.3	04/20/95	EPA 8020	TAT	100-41-4	
Toluene	ND	ug/kg	2.3	04/20/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	ND	ug/kg	5.8	04/20/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	130	%		04/20/95	EPA 8020	TAT	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	3.9	04/16/95	EPA Mod 8015 ext	EMA		
Gasoline	ND	mg/kg	3.9	04/16/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	3.9	04/16/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	3.9	04/16/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	3.9	04/16/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	3.9	04/16/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	3.9	04/16/95	EPA Mod 8015 ext	EMA		
Total Petroleum Hydrocarbons	ND	mg/kg	3.9	04/16/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	107	%		04/16/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	99	%		04/16/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

DATE: 05/09/95

Brown & Root Environmental
800 Oak Ridge Turnpike
Suite A-600
Oak Ridge, TN 37830

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114
SDG Number: BR4183

Attn: Mr. Allan Jenkins
Phone: 615-483-9900

Solid results are reported on a dry weight basis

PACE Sample No: 60283421 Date Collected: 04/07/95
Client Sample ID: E11-SU-SB1135A Date Received: 04/08/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	22.3	mg/kg	5.07	04/26/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/21/95				
O· ·ics								
·oisture								
·nt Moisture	21.1	%		04/11/95		KMN		
GC ·atiles								
Aromatic Volatile Organics								
Benzene	850	ug/kg	2.5	04/20/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	1100	ug/kg	2.5	04/20/95	EPA 8020	TAT	100-41-4	
Toluene	2700	ug/kg	2.5	04/20/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	5400	ug/kg	6.3	04/20/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	97	%		04/20/95	EPA 8020	TAT	2164-17-2	
TPH, Soil, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	38	mg/kg	6.3	04/19/95	EPA Mod 8015 ext	HMF		
a,a,a-Trifluorotoluene (S)	97	%		04/19/95	EPA Mod 8015 ext	HMF	2164-17-2	
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Gasoline	120	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4.2	04/15/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	101	%		04/15/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	96	%		04/15/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

9608 Loiret Blvd.
Lenexa, KS 66219
TEL: 913-599-5665
FAX: 913-599-1759

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ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 604183
Client Project ID: Eaker AFB - 0114

PACE Sample No:	60283447	Date Collected:	04/07/95
Client Sample ID:	E11-SU-SB1135B	Date Received:	04/08/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
Metals								
Lead, AAS Furnace								
Lead	21.4	mg/kg	2.73	04/26/95	EPA 7421	JAH	7439-92-1	
Date Digested				04/21/95				
Organics								
Moisture								
Percent Moisture	26.7	%		04/11/95		KMN		
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	6100	ug/kg	2.7	04/20/95	EPA 8020	TAT	71-43-2	
Ethyl Benzene	15000	ug/kg	2.7	04/20/95	EPA 8020	TAT	100-41-4	
Toluene	27000	ug/kg	2.7	04/20/95	EPA 8020	TAT	108-88-3	
Xylene (Total)	74000	ug/kg	6.8	04/20/95	EPA 8020	TAT	1330-20-7	
a,a,a-Trifluorotoluene (S)	140	%		04/20/95	EPA 8020	TAT	2164-17-2	
TPH, Soil, Purge by Mod. 8015								
Total Petroleum Hydrocarbons	570	mg/kg	68	04/19/95	EPA Mod 8015 ext	HMF		
a,a,a-Trifluorotoluene (S)	170	%		04/19/95	EPA Mod 8015 ext	HMF	2164-17-2	1
GC								
TPH, Soil, Ext. by Mod. 8015								
Mineral Spirits	ND	mg/kg	4.5	04/16/95	EPA Mod 8015 ext	EMA		
Gasoline	850	mg/kg	4.5	04/16/95	EPA Mod 8015 ext	EMA		
Jet Fuel	ND	mg/kg	4.5	04/16/95	EPA Mod 8015 ext	EMA		
Kerosene	ND	mg/kg	4.5	04/16/95	EPA Mod 8015 ext	EMA		
Diesel Fuel	ND	mg/kg	4.5	04/16/95	EPA Mod 8015 ext	EMA		
Fuel Oil	ND	mg/kg	4.5	04/16/95	EPA Mod 8015 ext	EMA		
Motor Oil	ND	mg/kg	4.5	04/16/95	EPA Mod 8015 ext	EMA		
Di-n-octylphthalate (S)	100	%		04/16/95	EPA Mod 8015 ext	EMA	117-84-0	
n-Tetracosane (S)	94	%		04/16/95	EPA Mod 8015 ext	EMA	646-31-1	
Date Extracted				04/14/95				

9608 Loiret Blvd.
Lenexa, KS 66219
TEL: 913-599-5665
FAX: 913-599-1759

PACE INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

PACE Project Number: 604906
Client Project ID: Eaker AFB - 0114

PACE Sample No: 60348075 — Date Collected: 06/02/95
Client Sample ID: E11-AW-TB11 — Date Received: 06/03/95

Parameters	Results	Units	PRL	Analyzed	Method	Analyst	CAS#	Footnotes
GC -- Volatiles								
Aromatic Volatile Organics								
Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	71-43-2	
Ethyl Benzene	ND	ug/L	2	06/14/95	EPA 8020	HMF	100-41-4	
Toluene	ND	ug/L	2	06/14/95	EPA 8020	HMF	108-88-3	
Xylene (Total)	ND	ug/L	5	06/14/95	EPA 8020	HMF	1330-20-7	
a,a,a-Trifluorotoluene (S)	107	%		06/14/95	EPA 8020	HMF	2164-17-2	

9608 Loiret Blvd.
Lenexa, KS 66219
TEL: 913-599-5665
FAX: 913-599-1759

STRAIGHT BILL OF LADING — SHORT FORM — Original — Not Negotiable

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of issue of this Original Bill of Lading,

(Name of Carrier) Goolsby Iron & Metal SCAC. ______ Shipper's No. ______ Carrier's No. ______

At 3002 West Main Date 9-25-95 From Air Force Base

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Uniform Freight Classification in effect on the date hereof, if this is a rail or a rail water shipment, or (2) in the applicable motor carrier classification or lawfully filed tariff if this is a motor carrier shipment.
Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those on the back thereof, set forth in the classification or lawfully filed tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Consigned to Goolsby Iron & Metal (Mail or street address of consignee — For purposes of notification only.)

Destination State AR, County Mississippi, Zip 72315

Delivery Address* 3002 W. Main

(*To be filled in only when shipper desires and governing lawfully filed tariffs provide for delivery thereat.)

Route from R4R International - Air Force Base

Delivering Carrier Goolsby Car or Vehicle Initials ______ No. ______

Number of Packages	KIND OF PACKAGE, DESCRIPTION OF ARTICLES, SPECIAL MARKS, AND EXCEPTIONS	*Weight (Sub. to Correction)	Class or Rate	Check Column
3	8' diameter tanks			
	UST's 160A, B, + C			

Subject to Section 7 of conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:
The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

(Signature of Consignor)

If charges are to be prepaid write or stamp here, "To be Prepaid".

Received $ ______ to apply in prepayment of the charges on the property described hereon.

Agent or Cashier

Per ______
(The Signature here acknowledges only the amount prepaid.)

Charges Advanced:

$ ______

Collect On Delivery $ 0 | and remit to | C.O.D. Charge to be paid by Shipper ☐ Consignee ☐

*If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading shall state whether it is carrier's or shipper's weight.
NOTE — Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property.
The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding ______ per ______

Where the applicable tariff provisions specify a limitation of the carrier's liability (NMFC Item 172), if there is no release or value declaration by the shipper, and the shipper does not declare a value or release the carrier's liability, that liability shall be limited to the extent provided by NMFC Item 172. California intrastate shipments must comply with NMFC Item 173.

"This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

Per ______

HM EMERGENCY RESPONSE TELEPHONE NUMBER

Monitored at all times the Hazardous Material is in transportation including storage incidental to transportation (172.604).

______ Shipper, Per ______ 1 ______ Agent, Per ______

Permanent post-office address of shipper.

FORM NO. 1 BLP-A (Rev. 10/91)

TA[illegible].14-1

GROUNDWATER ELEVATIONS
SWMU NO. 21, BASE EXCHANGE SHOPPETTE

Well No.	TOC Elevation	Ground Elevation	Groundwater Elevations in Feet Above Mean Sea Level							
			Dec. 11-19, 1991	Jan 9-13, 1992	Jan 14, 1992	Mar 27-28, 1992	May 29, 1992	May 7, 1995	Sept 13, 1995	Nov 19, 1995
Wells Screened in the Clay and Silt Aquitard										
TW1101	251.3	251.6	241.41	240.75	240.64	240.35	239.32	241.19	236.92	
TW1102	249.5	Not Surveyed	240.74		241.92	242.14	239.38	241.67	237.27	238.82
MW1104	251.5	Not Surveyed	241.40	241.50	241.00	240.58	239.55	241.55	235.97	237.92
TW1105	251.1	Not Surveyed		240.12				241.59		
TW1106	251.0	Not Surveyed	242.42	243.38	242.36	241.09	239.60	242.01	238.22	239.58
TW1108	250.7	Not Surveyed								240.45
TW1109	250.9	Not Surveyed	241.39	240.91		240.51	239.09	241.25	237.23	238.84
MW1110	251.2	Not Surveyed	241.38	241.49	240.88	240.48	239.09	241.01	237.25	237.49
MW1111	251.3	Not Surveyed	241.42	241.54	240.62	240.20	238.75	241.02	237.10	238.72
MW1114	251.6	Not Surveyed	245.40	244.78	241.54	245.13	241.37	244.09	240.21	239.30
MW1115	250.4	Not Surveyed	237.44	246.56	240.36	242.54	239.24	245.60	237.65	240.53
MW1116	250.6	Not Surveyed	240.13	243.37	243.50	242.84		241.77	237.53	238.95
MW1119	249.7	Not Surveyed	241.08	241.96	241.33	241.37	239.24	241.48	238.03	239.35
MW1120	251.7	Not Surveyed		241.48	241.51	241.11	239.33	240.80	237.01	238.64
MW1121	253.2	251.0							239.65	241.63
MW1122	253.0	250.7							236.92	238.51
MW1123	253.6	251.1							236.57	238.17
CP22	249.6	249.8						238.34	237.99	
CP26	250.8	251.1						244.93	238.97	
Wells Screened in the Sand Aquifer										
MW1124	253.6	251.9							236.41	238.47
MW1125	253.5	250.6								238.34
MW1126	253.7	250.6								238.63
MW1127	250.6	250.8								238.49
MW1128	250.6	251.4								238.16

TOC -- top of casing

TABLE 4.14-2

CHEMICALS DETECTED IN SUBSURFACE SOIL SWMU NO. 21, BASE EXCHANGE SHOPPETTE

Sample ID	E11-SU-TW1103A	E11-SU-TW1103B	E11-SU-TW1103C†	E11-SU-TW1108A	E11-SU-TW1108B†
Lab ID	P0183244	P0183245	P0183246	P0183379	P0183378
Depth	3'	10'	22'	5'	17'
Sample Data Group					
Site Name	SWMU21	SWMU21	SWMU21	SWMU21	SWMU21
Date Sampled	12/11/91	12/11/91	12/11/91	12/14/91	12/14/91
Date Analyzed	12/13/91	12/13/91	12/13/91	12/16/91	12/16/91
VOCs	BTEX Only	BTEX Only	BTEX Only	BTEX Only	BTEX Only
Benzene		0.077 mg/kg			
Ethylbenzene		0.127 mg/kg	0.008 mg/kg		1.000 mg/kg
Toluene		0.005 mg/kg	0.004 mg/kg		
Xylene (total)					
m-Xylene			0.017 mg/kg		
o-Xylene		0.013 mg/kg	0.004 mg/kg	3.000 mg/kg	
p-Xylene		0.084 mg/kg	0.004 mg/kg		
m + p Xylene	3.000 mg/kg				4.000 mg/kg
SVOCs	NA	NA	NA	NA	NA
Herbicides	NA	NA	NA	NA	NA
Pesticides	NA	NA	NA	NA	NA
PCBs	NA	NA	NA	NA	NA
Inorganics	NA	NA	NA	NA	NA
Nickel					
Miscellaneous					
TPH 418.1					
TPH Purgeables					
TPH Ext. Gasoline					

APPENDIX C

SOIL, SEDIMENT, GROUNDWATER, AND SURFACE WATER ANALYTICAL RESULTS

Evergreen
Analytical
Laboratory

CASE NARRATIVE

Evergreen Analytical Laboratory (EAL) Projects: 96-0904, 96-0928, 96-0955, 96-0979, 96-0995, 96-0998, 96-1082

Parsons Engineering Science, Inc. (PES) Project: Eaker AFB 722450.15020

Sample Receipt

Between March 26 and April 8, 1996, soil, groundwater and free products samples were received at EAL for analysis under Subcontract 722450.SC02. Refer to the EAL Check-in Record for specific information regarding the condition of samples upon receipt. Refer to the EAL Sample Log Sheet for specific log-in information and cross-reference of EAL and PES sample identifications.

Data Package

All data are reported in one comprehensive package that is segregated based upon EAL project number. Each EAL project represents a group of samples received on a given day. The EAL Sample Log Sheet summarizes the samples represented in each EAL project.

A separate invoice for each EAL project number will be generated.

Quality assurance data may overlap from one EAL project to another. All required matrix spike/matrix spike duplicate (MS/MSD) and laboratory control samples (LCS) were analyzed when required and also are included in the data package.

BTEX, Trimethylbenzenes, Tetramethylbenzene, Chlorobenzene, Method SW8020

All samples were analyzed for BTEX within holding time.

Several samples were analyzed at dilutions ranging from a dilution factor (DF) of 5 to 500,000 due to elevated levels of contaminants of interest. The reporting limits have been adjusted accordingly.

Samples ES-SED-1, -2 and -3 were analyzed with low surrogate recovery. The samples were reprepared and reanalyzed with similar results. Several of the samples associated with EAL project 96-0904 are footnoted to indicate that hydrocarbon interference made surrogate separation difficult.

The MS/MSD samples associated with EAL project 96-0904 also exhibited hydrocarbon interference. The reports are footnoted. The LCS sample recoveries associated with these projects are within the EAL control limits, therefore the data are considered to be acceptable.

Total Volatile Petroleum Hydrocarbons, TVPH Method 8015M
There are no quality control anomalies to report.

Total Extractable Petroleum Hydrocarbons, TEPH Method 8015M
All samples submitted for TEPH analysis were analyzed within holding time.

Samples 457-MPA-5-6.5, 457-MPB-5-6, and 702-MPB-5.5-6 were analyzed at a dilution factor of ten due to elevated levels of contamination in the samples.

457-MPB-5-6 MS/MSD recoveries are not meaningful due to contaminant interference. The LCS recoveries were within EAL control limits.

Surrogates were either diluted out of or were inseparable from analytes for all soils submitted for TEPH.

Methane, Method RSKSOP175M
Samples TW-1105, ESMP23-D, ESMP-22 and ESMP-7S were analyzed at dilutions ranging from DF of 50 to 100. The reporting limits were adjusted accordingly.

There are no other quality control anomalies to report.

Anions, Method E300.0
The nitrate/nitrite analysis for samples in EAL projects 96-0979 and 96-0995 were reanalyzed outside of holding time due to instrument problems. In the initial and re-analysis, no nitrite was detected. This would indicate that no conversion between NO_2 and NO_3 occurred prior to re-analysis.

There are no other quality control anomalies to report.

General Chemistry
There are no quality control anomalies to report for the following analyses: alkalinity by Method 310.1, total organic carbon in water by Method E415.1, density by Method ASTMD287, pH by Method E150.1 or percent moisture by Method SW846.

Total Organic Carbon in Soil

Total Organic Carbon (TOC) in soil was analyzed by Huffman Laboratories of Golden, Colorado. TOC was determined by analyzing for total carbon (TC) and inorganic (carbonate) carbon (CC), then calculating the difference as TOC. The reports from Huffman are included.

Soil Classification (Sieve Analysis)

Soil classification (sieve analysis) was analyzed by Hazen Research, Inc. of Golden, Colorado. The report from Hazen is included. Soil classification analyses are not included with the disk deliverables.

Disk Deliverables

The disk deliverables are included with the hard copy data package. MS/MSD and laboratory duplicate samples are not included on the disk. Please note that blank spaces in the laboratory detection limit and/or practical quantitation limit (PQL) column indicate that there is no detection limit or PQL for that analyte.

Reporting limits have been adjusted to reflect percent moisture in all soil samples or increases due to dilutions.

A hard copy of each spreadsheet included on the diskette is included. The name for each spreadsheet is located in the top left corner on the first page of each printout.

Patricia A. McClellan

Patricia A. McClellan, Program Manager
4/26/96

Evergreen Analytical Sample Log Sheet

Project # 96-0928

Date(s) Sampled: 03/26/96 COC

Date Due: 04/03/96-*BTEX/TVH
04/10/96-OTHERS

[illegible]te Received: 03/27/96 0928

Holding Time(s): NO2/NO3-3/28

[illegible]nt Project I.D. 722450.15020 EAKER AFB

Rush STANDARD

Client: PARSONS ENGINEERING SCIENCE
Address: 1700 BROADWAY SUITE 900
DENVER, CO 80290
Contact: TODD HERRINGTON
Phone #831-8100 Fax #831-8208

Cooler Return N/A
E.A. Cooler # 713
Airbill # FEDEX 7221153763
Client P.O.

Special Invoicing/Billing

Special Instructions *INCLUDES TMBs, TeMB, AND CHLOROBENZENE.

Lab ID #	Client ID#	Analysis	Mtx	Btl	Loc
X21242A-D	MW-1127	*BTEX/TVH	W	40V	2
X21243A-D	MW-1116	*BTEX/TVH	W	40V	2
[illegible]1244A-D	TW-1125	*BTEX/TVH	W	40V	2
[illegible]45A-D	MW-1124	*BTEX/TVH	W	40V	2
X[illegible]46A-D	MW-1123	*BTEX/TVH	W	40V	2
X21247A-D	MW-1120	*BTEX/TVH	W	40V	2
X21248A	TRIP BLANK	*BTEX/TVH	W	40V	2
X21242E-G	MW-1127	METHANE	W	40V	2
X21243E-G	MW-1116	METHANE	W	40V	2
X21244E-G	TW-1125	METHANE	W	40V	2
X21245E-G	MW-1124	METHANE	W	40V	2
X21246E-G	MW-1123	METHANE	W	40V	2
X21247E-G	MW-1120	METHANE	W	40V	2
X21242H	MW-1127	Cl, NO2, NO3, SO4	W	125P	E5
X21243H	MW-1116	Cl, NO2, NO3, SO4	W	125P	E5
X21244H	TW-1125	Cl, NO2, NO3, SO4	W	125P	E5
X21245H	MW-1124	Cl, NO2, NO3, SO4	W	125P	E5
X21246H	MW-1123	Cl, NO2, NO3, SO4	W	125P	E5
X21247H	MW-1120	Cl, NO2, NO3, SO4	W	125P	E5

[illegible]=Sample to be returned

[illegible] GC/MS ___ GC X Metals ___ Wet Chem X HPLC ___ SxPrep ___

T[illegible] SxRec C QA/QC C Acctg C File Orig

Page 1 of 1 Page(s)

Custodian/Date: MM 3/28/96
[illegible] 3/29/96

Lab ID #	Client ID#	Analysis	Mtx	Btl	Loc
X21242I	MW-1127	ALKALINITY	W	125P	E5
X21244I	TW-1125	ALKALINITY	W	125P	E5
X21245I	MW-1124	ALKALINITY	W	125P	E5
X21242J	MW-1127	TOC	W	125P	E5
X21244J	TW-1125	TOC	W	125P	E5
X21245J	MW-1124	TOC	W	125P	E5

Project # 96-0928

R=Sample to be returned

CHAIN OF CUSTODY RECORD / [illegible]NALYTICAL SERVICES REQUEST

Evergr[illegible] Analytical Inc.

4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400
FAX RESULTS Y / N

Page 1 of ____

COMPANY Parsons ES
ADDRESS 1700 Broadway
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208

CLIENT CONTACT (print) Todd Herrington
PROJECT I.D. 722450.15020
EAL QUOTE # ____ P.O.# ____
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ____
*expedited turnaround subject to additional fee

Sampler Name:
(signature) [illegible]
(print) Shin Ozaki + Saskia H[illegible]
Evergreen Analytical Cooler No. 713
Cooler Received ____

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL Project # 96-0928
Custodian MW

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Methane	Cl^-, NO_2, NO_3, SO_4	Alkalinity	TOC	EAL Sample No.
MW-1127	3/26/96	14:10	10	X										X		X				X	X	X	X	X21242 A-J
MW-1116	3/26/96	14:30	8	X										X		X				X	X			43 A-H
TW-1125	3/26/96	15:00	10	X										X		X				X	X	X	X	44 A-J
MW-1124	3/26/96	15:15	10	X										X		X				X	X	X	X	45 A-J
MW-1123	3/26/96	15:30	8	X										X		X				X	X			46 A-H
MW-11[illegible]	3/26/96	15:50	[illegible]	X										X		X				X	X			47 A-H
TRIP BLANK														X		X								48 A
HT:																								Location 2, E5
DD:														40V		40V				40V	125 P	125 P	125 A	Container Size

Instructions:
Analyze trip blank for BTEX/TVPH per Mark Vessely pm. 3/27/96

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[illegible]	3/26/96					[illegible]	3/27/96 0928

3/27 pm

Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3/~~26~~ 27/96 0928 mpm Shipped Via: FedX 722115 3763
(Airbill # if applicable)

Client : Parsons ES

Client Project ID(s): 722450.15020

EAL Project #(s): 96-0928 EAL Cooler(s): Y N

Cooler#	713				
Ice packs	Y N	Y N	Y N	Y N	Y N
Temperature °C	8				

	Y	N	N/A
1. Custody seal(s) present:		X	
Seals on cooler intact			X
Seals on bottle intact			X
2. Chain of Custody present:	X		
3. Samples Radioactive: (Comment on COC if >0.5mr/h)		X	
4. Containers broken or leaking: (Comment on COC if Y)	~~X~~	X mpm	
5. Containers labeled:	X		
6. COC agrees w/ bottles received: (Comment on COC if N)	X		
7. COC agrees w/ labels: (Comment on COC if N)	X		
8. Headspace in vials-waters only: (Comment on COC if Y) In two BTEX sample ID MW-1127.	X		
9. VOA samples preserved:	X		
10. pH measured on metals, cyanide or phenolics*:			X

List discrepancies ______

*Non-EAL provided containers only, water samples only.

	Y	N
11. Metal samples present:		X
Total ______ , Dissolved ______ , TCLP ______		
D or PD to be filtered:		
T,TR,D,PD to be Preserved:		
12. Short holding times:	X	
Specify parameters NO2/NO3		
13. Multi-phase sample(s) present:		X
14. COC signed w/ date/time:	X	

Comments: ______

(Additional comments on back)

Custodian Signature/Date: mpm 3/27/96

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB032796B	Client Project Number	: 722450.15020
Date Prepared	: 3/27/96	Lab Project Number	: 96-0928
Dilution Factor	: 1.0	Matrix	: WATER
		Lab File Number	: TVBX0326044

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/27/96	U	0.1	mg/L
Benzene	71-43-2	3/27/96	U	0.4	ug/L
Toluene	108-88-3	3/27/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/27/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/27/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/27/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/27/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/27/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/27/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/27/96	U	0.5	ug/L
FID Surrogate Recovery:		97%		70%-130%	(Limits)
'ID Surrogate Recovery:		93%		70%-128%	(Limits)

es: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Holleman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

nt Sample Number	: MW-1127	Client Project Number	: 722450.15020
Lab Sample Number	: X21242	Lab Project Number	: 96-0928
Date Sampled	: 3/26/96	Matrix	: WATER
Date Received	: 3/27/96	Lab File Number(s)	: TVBX0326077
Date Prepared	: 3/28/96	Method Blank	: MB032796B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/28/96	0.1	0.1	mg/L
Benzene	71-43-2	3/28/96	35	0.4	ug/L
Toluene	108-88-3	3/28/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/28/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/28/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/28/96	0.4	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/28/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/28/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/28/96	0.5	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/28/96	U	0.5	ug/L
ID Surrogate Recovery:		92%		70%-130%	(Limits)
Surrogate Recovery:		86%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

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U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

Approved

TVBP0928.XLS; 3/28/96; 2

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MW-1116	Client Project Number	: 722450.15020
Lab Sample Number	: X21243	Lab Project Number	: 96-0928
Date Sampled	: 3/26/96	Matrix	: WATER
Date Received	: 3/27/96	Lab File Number(s)	: TVBX0326050
Date Prepared	: 3/27/96	Method Blank	: MB032796B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/27/96	U	0.1	mg/L
Benzene	71-43-2	3/27/96	U	0.4	ug/L
Toluene	108-88-3	3/27/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/27/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/27/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/27/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/27/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/27/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/27/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/27/96	U	0.5	ug/L
FID Surrogate Recovery:		97%		70%-130%	(Limits)
PID Surrogate Recovery:		94%		70%-128%	(Limits)

Notes: Total Xylanes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

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B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

Approved

TVBP0928.XLS; 3/28/96; 3

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

ent Sample Number	:	TW-1125	Client Project Number	:	722450.15020
Lab Sample Number	:	X21244	Lab Project Number	:	96-0928
Date Sampled	:	3/26/96	Matrix	:	WATER
Date Received	:	3/27/96	Lab File Number(s)	:	TVBX0326051
Date Prepared	:	3/27/96	Method Blank	:	MB032796B
FID Dilution Factor	:	1.0			
PID Dilution Factor	:	1.0			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/27/96	U	0.1	mg/L
Benzene	71-43-2	3/27/96	1.0	0.4	ug/L
Toluene	108-88-3	3/27/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/27/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/27/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/27/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/27/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/27/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/27/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/27/96	U	0.5	ug/L
'ID Surrogate Recovery:		96%		70%-130%	(Limits)
Surrogate Recovery:		92%		70%-128%	(Limits)

otes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

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RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

nt Sample Number	:	MW-1124	Client Project Number	:	722450.15020
Lab Sample Number	:	X21245	Lab Project Number	:	96-0928
Date Sampled	:	3/26/96	Matrix	:	WATER
Date Received	:	3/27/96	Lab File Number(s)	:	TVBX0326052
Date Prepared	:	3/27/96	Method Blank	:	MB032796B
FID Dilution Factor	:	1.0			
PID Dilution Factor	:	1.0			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/27/96	U	0.1	mg/L
Benzene	71-43-2	3/27/96	U	0.4	ug/L
Toluene	108-88-3	3/27/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/27/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/27/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/27/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/27/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/27/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/27/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/27/96	U	0.5	ug/L
ID Surrogate Recovery:		96%		70%-130%	(Limits)
Surrogate Recovery:		92%		70%-128%	(Limits)

otes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

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TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MW-1123	Client Project Number	: 722450.15020
Lab Sample Number	: X21246	Lab Project Number	: 96-0928
Date Sampled	: 3/26/96	Matrix	: WATER
Date Received	: 3/27/96	Lab File Number(s)	: TVBX0326056
Date Prepared	: 3/27/96	Method Blank	: MB032796B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/28/96	U	0.1	mg/L
Benzene	71-43-2	3/28/96	U	0.4	ug/L
Toluene	108-88-3	3/28/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/28/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/28/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/28/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/28/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/28/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/28/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/28/96	U	0.5	ug/L
FID Surrogate Recovery:		95%		70%-130%	(Limits)
PID Surrogate Recovery:		91%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

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TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MW-1120	Client Project Number	: 722450.15020
Lab Sample Number	: X21247	Lab Project Number	: 96-0928
Date Sampled	: 3/26/96	Matrix	: WATER
Date Received	: 3/27/96	Lab File Number(s)	: TVBX0326057
Date Prepared	: 3/27/96	Method Blank	: MB032796B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/28/96	U	0.1	mg/L
Benzene	71-43-2	3/28/96	U	0.4	ug/L
Toluene	108-88-3	3/28/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/28/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/28/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/28/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/28/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/28/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/28/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/28/96	U	0.5	ug/L
FID Surrogate Recovery:		94%		70%-130%	(Limits)
PID Surrogate Recovery:		92%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: TRIP BLANK	Client Project Number	: 722450.15020
Lab Sample Number	: X21248	Lab Project Number	: 96-0928
Date Sampled	: NA	Matrix	: WATER
Date Received	: 3/27/96	Lab File Number(s)	: TVBX0326045
Date Prepared	: 3/27/96	Method Blank	: MB032796B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/27/96	U	0.1	mg/L
Benzene	71-43-2	3/27/96	U	0.4	ug/L
Toluene	108-88-3	3/27/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/27/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/27/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/27/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/27/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/27/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/27/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/27/96	U	0.5	ug/L
ID Surrogate Recovery:		95%		70%-130%	(Limits)
Surrogate Recovery:		92%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

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TVBP0928.XLS; 3/28/96; 8

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
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TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
TVH Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	: MW-1125	Client Project No.	: 722450.15020
Lab Sample No.	: X21244	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	EPA Method No.	: 5030/8015 Modified
Date Received	: 3/27/96	Matrix	: WATER
Date Prepared	: 3/27/96	Lab File Number(s)	: TVBX0326059,60
Date Analyzed	: 3/28/96	Method Blank	: MB032796B
		Dilution Factor	: 1.0

Compound	Spike Added (mg/L)	Sample Concentration (mg/L)	MS Concentration (mg/L)	MS %REC	QC*** Limits %REC
Gasoline	2.00	0.00	1.83	91.5%	57-126
Surrogate **	---	---	---	93%	70-128

Compound	Spike Added (mg/L)	MSD Concentration (mg/L)	MSD %REC	RPD	QC*** Limits RPD	QC*** Limits %REC
Gasoline	2.00	1.92	96.0%	4.8	28.2	57-126
Surrogate **	---	---	96%	NA	NA	70-128

RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

Notes:
NA = Not analyzed/not applicable.
* = Value outside of QC limits.
** = 1,2,4-Trichlorobenzene
*** =Limits established 3/8/96. KSH

Comments:

K Hollman
Analyst

Approved

MSTV0928.XLS; 3/28/96; 3:21 PM

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	: MW-1116	Client Project No.	: 722450.15020
Lab Sample No.	: X21243	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	EPA Method No.	: 602/8020
Date Received	: 3/27/96	Matrix	: Water
Date Prepared	: 3/27/96	Lab File Number(s)	: TVBX0326061,62
Date Analyzed	: 3/28/96	Method Blank	: MB032796B
		Dilution Factor	: 1.0

Compound	Spike Added (ug/L)	Sample Concentration (ug/L)	Concentration (ug/L)		Comments
			MS	MSD	
Benzene	20.0	0.0	17.3	17.5	
Toluene	20.0	0.0	17.6	18.0	
Chlorobenzene	20.0	0.0	17.5	18.0	
Ethylbenzene	20.0	0.0	17.7	18.0	
m,p-Xylene	20.0	0.0	17.8	18.1	
o-Xylene	20.0	0.0	17.5	18.1	
1,3,5-TMB	20.0	0.0	17.4	17.7	
1,2,4-TMB	20.0	0.0	17.7	17.8	
1,2,3-TMB	20.0	0.0	17.2	17.7	
1,2,3,4-TeMB	20.0	0.0	17.7	18.0	
Surrogate	100.0	94%	93%	91%	% RECOVERY

Compound		MS % RECOVERY	MSD % RECOVERY	RPD	QC# Limits			
					RPD	%REC		
Benzene		86.5	87.5	1.1	25	50	-	150
Toluene		88.0	90.0	2.2	25	50	-	148
Chlorobenzene		87.5	90.0	2.8	25	55	-	135
Ethylbenzene		88.5	90.0	1.7	25	50	-	150
m,p-Xylene		89.0	90.5	1.7	25	50	-	150
o-Xylene		87.5	90.5	3.4	25	50	-	150
1,3,5-TMB		87.0	88.5	1.7	25	50	-	150
1,2,4-TMB		88.5	89.0	0.6	25	50	-	150
1,2,3-TMB		86.0	88.5	2.9	25	50	-	150
1,2,3,4-TeMB		88.5	90.0	1.7	25	50	-	150
Surrogate		93.0	91.0	NA	NA	70	-	128

#= Values taken from EPA methods 602/8020.
*= Values outside of QC limits.

RPD: 0 out of (10) outside limits.
Spike Recovery: 0 out of (20) outside limits.

Comments:

K. Hollman
Analyst

[illegible]
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St.
Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Data Report
Laboratory Control Sample (LCS)

LCS Number	:	LCS032596-BW	Dilution Factor	:	1.00
Date Extracted/Prepared	:	3/25/96	Method	:	602/8020
Date Analyzed	:	3/26/96	Matrix	:	Water
Spike Amount (ug/L)	:	20.0	Lab File No.	:	TVBX0323056

Compound Name	Cas Number	LCS Concentration (ug/L)	LCS % Recovery	QC Limit** % Recovery
Benzene	71-43-2	18.6	93.0	73 - 122
Toluene	108-88-3	18.5	92.5	77 - 125
Chlorobenzene	108-90-7	17.3	86.5	82 - 122
Ethyl Benzene	100-41-4	18.4	92.0	78 - 126
m,p-Xylene	108-38-3 106-42-3	36.3	90.8	78 - 127
Xylene	95-47-6	18.0	90.0	77 - 125
[illegible]	1634-04-4	20.0	100.0	50 - 150
1,3,5-Trimethylbenzene	108-67-8	18.6	93.0	66 - 135
1,2,4-Trimethylbenzene	95-63-6	18.5	92.5	72 - 121
1,2,3-Trimethylbenzene	526-73-8	21.1	105.5	71 - 121
1,2,3,4-Tetramethylbenzene	488-23-3	19.2	96.0	58 - 147
Surrogate Recovery:		93%		70 - 128

NOTES: m,p-xylene = 40.0 ppb spike.

QUALIFIERS:

E = Extrapolated value. Value exceeds that of the calibration range.
U = Compound analyzed for, but not detected.
B = Compound found in blank and sample. Compare blank and sample data.
NA = Not available/Not analyzed.
= Limits established 3/11/96 for TVHBTEX2. KSH

K. Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
Laboratory Control Sample (LCS)

LCS Number	: LCS032696-GW	Matrix	: WATER
Date Prepared	: 3/26/96	Method Numbers	: EPA 5030/8015 Modified
Date Analyzed	: 3/27/96		
Lab File Number(s)	: TVBX0326028		

Compound Name	Theoretical Concentration (mg/L)	LCS Concentration (mg/L)	LCS % Recovery	QC Limit** % Recovery
Gasoline	2.00	2.22	111.0	78 - 137
Surrogate Recovery:		94%		70 - 130

QUALIFIERS

B = TVH as Gasoline found in blank also.
E = Extrapolated value. Value exceeds calibration range.
NA=Not Available/Not Applicable.
** = Limits established 3/11/96 for TVHBTEX2. KSH

K. Hollman
Analyst

P. McClella
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form
Method Blank Report

Method Blank Number	: GB040196	Client Project No.	: 722450.15020
Date Extracted/Prepared	: 4/1/96	Lab Project No.	: 96-0928
Date Analyzed	: 4/1/96	Dilution Factor	: 1.00
		Method	: RSKSOP-175
		Matrix	: Water
		Lab File No.	: GAS0401002

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0928.XLS

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(303) 425-6021

Methane Report Form

t Sample Number	: MW-1127	Client Project No.	: 722450.15020
Lab Sample Number	: X21242	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/27/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401006

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

mperature	: 78.6 F	Saturation Concentration	Meth	0
unt Injected	: 0.5 ml			
Volume of Sample	: 43 ml	Concentration in Head Space	Meth	0
space created	: 4 ml			
Methane Area	: 0 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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(303) 425-6021

Methane Report Form

Sample Number	: MW-1116	Client Project No.	: 722450.15020
Lab Sample Number	: X21243	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/27/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401007

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

mperature	: 77.1 F	Saturation	Meth	0
unt Injected	: 0.5 ml	Concentration		
olume of Sample	: 43 ml	Concentration	Meth	0
space created	: 4 ml	in Head Space		
Methane Area	: 0 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

[redacted] Sample Number	: TW-1125	Client Project No.	: 722450.15020
Lab Sample Number	: X21244	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/27/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401010

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.002	0.002

Temperature	: 76.4 F	Saturation Concentration	Meth	0.000549528
[redacted]ount Injected	: 0.5 ml			
[redacted]olume of Sample	: 43 ml	Concentration in Head Space	Meth	0.001717223
H[redacted] space created	: 4 ml			
Methane Area	: 12.779 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

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EVERGREEN ANALYTICAL, INC.
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(303) 425-6021

Methane Report Form

Sample Number	: TW-1125	Client Project No.	: 722450.15020
Lab Sample Number	: X21244Dup	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/27/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401011

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.003	0.002

Temperature	: 76.6 F	Saturation Concentration	Meth	0.000705885
Amount Injected	: 0.5 ml			
Volume of Sample	: 43 ml	Concentration in Head Space	Meth	0.002205
Head space created	: 4 ml			
Methane Area	: 16.415 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

[redacted]Sample Number	: MW-1124	Client Project No.	: 722450.15020
Lab Sample Number	: X21245	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/27/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401012

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.026	0.002

nperature	: 76.9 F	Saturation	Meth	0.006368616
[redacted]nt Injected	: 0.5 ml	Concentration		
T[redacted]olume of Sample	: 43 ml	Concentration	Meth	0.019882767
He[redacted] space created	: 4 ml	in Head Space		
Methane Area	: 148.099 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

t Sample Number	: MW-1123	Client Project No.	: 722450.15020
Lab Sample Number	: X21246	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/27/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401013

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

mperature	: 76.4 F	Saturation Concentration	Meth 0
unt Injected	: 0.5 ml		
Volume of Sample	: 43 ml	Concentration in Head Space	Meth 0
space created	: 4 ml		
Methane Area	: 0 ug		

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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(303) 425-6021

Methane Report Form

Sample Number	: MW-1122	Client Project No.	: 722450.15020
Lab Sample Number	: X21247	Lab Project No.	: 96-0928
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/27/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401014

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 76.5 F	Saturation Concentration	Meth	0
Amount Injected	: 0.5 ml			
Volume of Sample	: 43 ml	Concentration in Head Space	Meth	0
Head space created	: 4 ml			
Methane Area	: 0 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

RSK-175 Gas Method
Methane, Ethane, Ethene Gas Matrix Spike / Matrix Spike Duplicate Report

Client Sample No.	:	MW-1116	Client Project No.	:	722450.15020
Lab Sample No.	:	X21243	Lab Project No.	:	96-0928
Date Sampled	:	3/26/96	EPA Method No.	:	RSKSOP-175
Date Received	:	3/27/96	Matrix	:	Water
Date Prepared	:	4/1/96	Method Blank	:	GB040196
Date Analyzed	:	4/1/96	Lab File No's.	:	GAS0401008,009
E.A. MS/MSD Spike Source No.	:	1723			

Compound	Spike Added (ug)	Sample Concentration (ug)	MS Concentration (ug)	MS %REC	QC Limits %REC
Methane Gas	500	0	387	77	40-89

Compound	Spike Added (ug)	MSD Concentration (ug)	MSD %REC	RPD	QC Limits RPD	QC Limits %REC
Methane Gas	500	391	78	1.0	0-24.4	40-89

RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

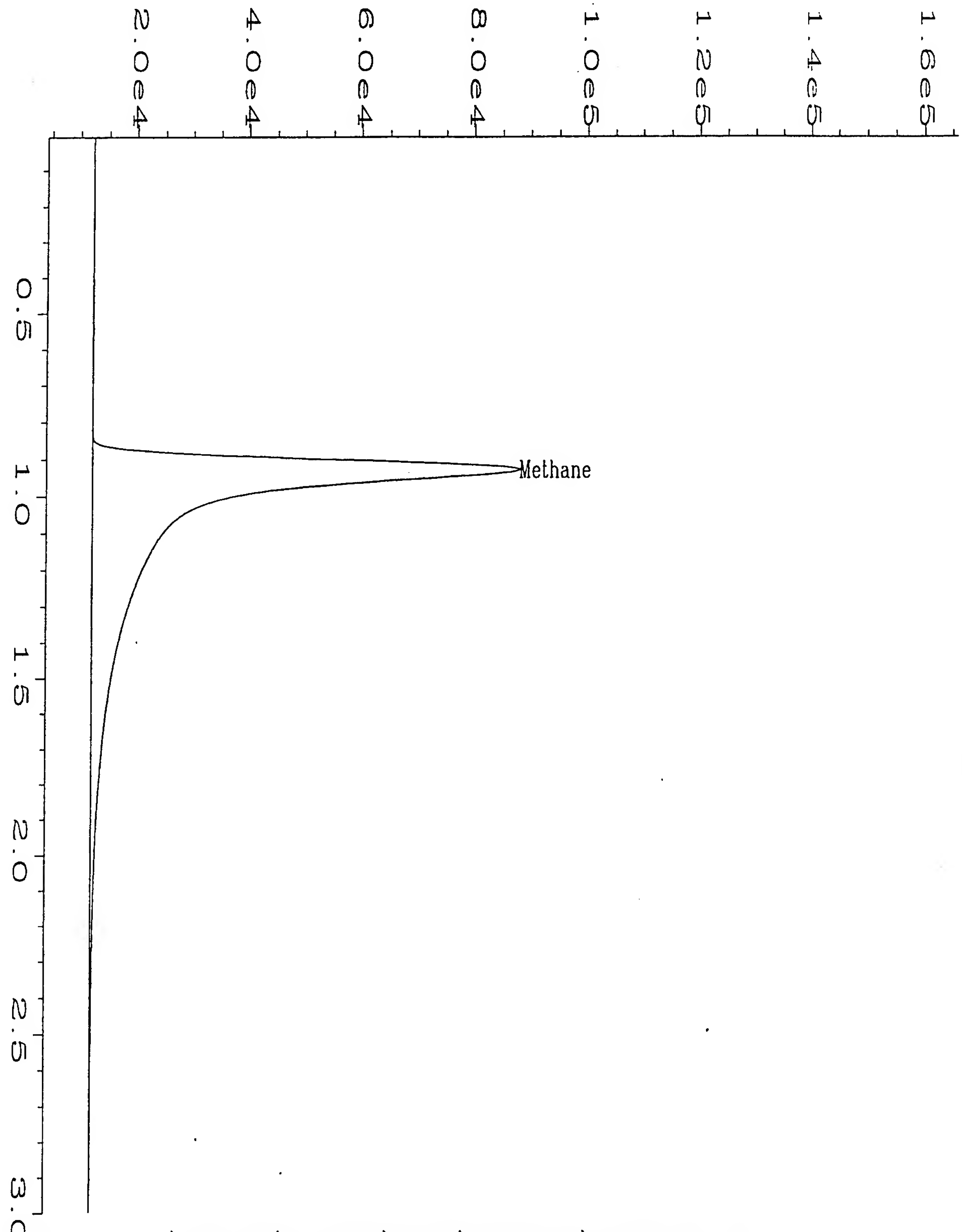
NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available

Note: The Spike was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

Analyst

Approved

MS0928.XLS; 4/2/96



Data File Name	: C:\HPCHEM\ALCGAS\DATA\GAS0401\009R0101.D		
Operator	: Bill Michener	Page Number	: 1
Instrument	: ALCGAS	Vial Number	: 9
Sample Name	: X21243MSD;1	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 1
Acquired on	: 01 Apr 96 12:20 PM	Instrument Method:	GAS.MTH
Report Created on:	02 Apr 96 07:24 AM	Analysis Method	: GAS040 H
Last Recalib on	: 25 MAR 96 09:44 AM	Sample Amount	: 0
Multiplier	: 1	ISTD Amount	:

Sample Info : 96-0928;MW-1116;Displaced 4ml with 1% methane gas(#1723), shook for 5 min. and injected 50ul to equal a theoretical spike of 500ug. The sample is injected at a DF=10

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

RSK-175 Gas Method
Methane LCS Report Form

LCS No.	: LCS040196	EPA Method No.	: RSKSOP-175
Date Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Method Blank	: GB040196
E.A. LCS Source No.	: 1723	Lab File No.	: GAS0401005

Compound	Spike Added (ug)	Method Blank Concentration (ug)	LCS Concentration (ug)	LCS %REC	QC Limits %REC
Methane Gas	500	0	399	80	67-85

Spike Recovery: 0 out of (1) outside limits.

Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/26/96	Client Project ID.	: 722450.15020
Date Received	: 3/27/96	Lab Project Number	: 96-0928
Date Prepared	: 3/28/96	Method	: EPA 300.0
Date Analyzed	: 3/28/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Chloride mg/L	Dilution Factor
X21242	MW-1127	Water	4.2	1
X21242	MW-1127 Duplicate	Water	3.3	1
X21243	MW-1116	Water	5.0	1
X21244	TW-1125	Water	3.6	1
X21245	MW-1124	Water	4.9	1
X21246	MW-1123	Water	4.0	1
X21247	MW-1120	Water	2.7	1
Method Blank	(3/28/96)		<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21242	MW-1127 Matrix Spike	10.0	4.2	12.2	80
X21242	MW-1127 Matrix Spike Dup	10.0	4.2	12.4	82
MS/MSD RPD					3.0

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.

4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/26/96	Client Project ID.	: 722450.15020
Date Received	: 3/27/96	Lab Project Number	: 96-0928
Date Prepared	: 3/28/96	Method	: EPA 300.0
Date Analyzed	: 3/28/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
X21242	MW-1127	Water	<0.076	1
X21242	MW-1127 Duplicate	Water	<0.076	1
X21243	MW-1116	Water	<0.076	1
X21244	TW-1125	Water	<0.076	1
X21245	MW-1124	Water	<0.076	1
X21246	MW-1123	Water	<0.076	1
X21247	MW-1120	Water	<0.076	1
Method Blank	(3/28/96)		<0.076	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21242	MW-1127 Matrix Spike	10.0	<0.25	9.2	92
X21242	MW-1127 Matrix Spike Dup	10.0	<0.25	9.1	91
MS/MSD RPD					0.8

* = Quality assurance results reported as Nitrite (NO_2).

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	:	3/26/96	Client Project ID.	:	722450.15020
Date Received	:	3/27/96	Lab Project Number	:	96-0928
Date Prepared	:	3/28/96	Method	:	EPA 300.0
Date Analyzed	:	3/28/96	Detection Limit	:	0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
X21242	MW-1127	Water	<0.056	1
X21242	MW-1127 Duplicate	Water	<0.056	1
X21243	MW-1116	Water	0.46	1
X21244	TW-1125	Water	<0.056	1
X21245	MW-1124	Water	<0.056	1
X21246	MW-1123	Water	0.13	1
X21247	MW-1120	Water	0.073	1
Method Blank	(3/28/96)		<0.056	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21242	MW-1127 Matrix Spike	10.0	<0.25	9.0	90
X21242	MW-1127 Matrix Spike Dup	10.0	<0.25	8.9	89
MS/MSD RPD					0.6

* = Quality assurance results reported as Nitrate (NO_3).

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/26/96	Client Project ID.	: 722450.15020
Date Received	: 3/27/96	Lab Project Number	: 96-0928
Date Prepared	: 3/28/96	Method	: EPA 300.0
Date Analyzed	: 3/28/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
X21242	MW-1127	Water	10.0	1
X21242	MW-1127 Duplicate	Water	9.9	1
X21243	MW-1116	Water	44.4	10
X21244	TW-1125	Water	89.1	10
X21245	MW-1124	Water	29.8	1
X21246	MW-1123	Water	13.9	1
X21247	MW-1120	Water	19.7	1
Method Blank	(3/28/96)		<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21242	MW-1127 Matrix Spike	10.0	10.0	18.8	88
X21242	MW-1127 Matrix Spike Dup	10.0	10.0	18.6	86
MS/MSD RPD					2.2

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Analysis Report

Date Sampled	: 3/26/96	Client Project ID.	: 722450.15020
Date Received	: 3/27/96	Lab Project Number	: 96-0928
Date Prepared	: 4/1/96	Method	: EPA 310.1
Date Analyzed	: 4/1/96	Detection Limit	: 5.0 mg $CaCO_3$/L

Evergreen Sample #	Client Sample ID.	Matrix	Total Alkalinity (mg $CaCO_3$/L)	Dilution Factor
X21242	MW-1127	Water	241	1
X21244	TW-1125	Water	161	1
X21244 Dup	TW-1125 Dup	Water	162	1
X21245	MW-1124	Water	117	1
Method Blank	(4/1/96)		<5.0	

Quality Assurance

Reference	True Value (mg$CaCO_3$/L)	Result (mg$CaCO_3$/L)	% Recovery
ERA Alkalinity Lot # 0814-95-02	120	125	104

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Total Organic Carbon

Date Sampled	: 3/26/96		Client Project ID.	: 722450.15020
Date Received	: 3/27/96		Lab Project Number	: 96-0928
Date Prepared	: 3/28/96		Method	: EPA 415.1
Date Analyzed	: 3/28/96		Detection Limit	: 1.0 mg C/L

Evergreen Sample #	Client Sample ID.	Matrix	TOC mg C/L	Dilution Factor
X21242	MW-1127	Water	10.6	10
X21244	TW-1125	Water	1.3	1
X21244 Dup	TW-1125 Dup	Water	1.7	1
X21245	MW-1124	Water	4.2	1
Method Blank	(3/28/96)		<1.0	

Quality Assurance

		Spike Amount (mgC/L)	Sample Result (mgC/L)	Spike Result (mgC/L)	% Recovery
X21244	TW-1125 Matrix Spike	10.0	1.3	12.4	108
X21244	TW-1125 Matrix Spike Dup	10.0	1.3	12.9	112
MS/MSD RPD					4.4

Analyst

Approved

Evergreen Analytical Sample Log Sheet

Project # 96-0955

Date(s) Sampled: 03/26,27/96 COC

Date Due: 04/04/96-UST
04/11/96-OTHERS

Date Received: 03/28/96 1000

Holding Time(s): 3/28,29-NO_2,NO_3
4/09,10-BTEX,TVH,METHANE,ALKALINITY

ent Project I.D. 722450.15020 EAKER AFB

Rush STANDARD

Client: PARSONS ENGINEERING SCIENCE, INC.

Cooler Return N/A

Address: 1700 BROADWAY SUITE 900
DENVER, CO 80290

E.A. Cooler # 604

Airbill # FEDEX 7221153741

Contact: TODD HERRINGTON

Client P.O.

Phone #831-8100 **Fax #**831-8208

Special Invoicing/Billing

Special Instructions +CHLOROBENZENE, TMB's & TeMB; *TWO BOTTLES LABELED "TW-1110", SAMPLED AT 08:40.

Lab ID #	Client ID#	Analysis	Mtx	Btl	Loc
X21362A-D	MW1122	BTEX+,TVH	W	40V	2
X21363A-D	MW1121	BTEX+,TVH	W	40V	2
X21364A-D	MW1126	BTEX+,TVH	W	40V	2
X21365A-D	TW-1110D	BTEX+,TVH	W	40V	2
366A-D	MW1119	BTEX+,TVH	W	40V	2
X 7A-D	MW1109	BTEX+,TVH	W	40V	2
X2 8A-D	*MW1110	BTEX+,TVH	W	40V	2
X21369A-D	MW-1104	BTEX+,TVH	W	40V	2
X21371A-D	TW-1106	BTEX+,TVH	W	40V	2
X21372A-D	TW1102	BTEX+,TVH	W	40V	2
X21373A-D	TW1111	BTEX+,TVH	W	40V	2
X21376A	TRIP BLANK	BTEX+,TVH	W	40V	2
X21377A-D	ESMP-6D	BTEX+,TVH	W	40V	2
X21362E-G	MW1122	METHANE	W	40V	2
X21363E-G	MW1121	METHANE	W	40V	2
X21364E-G	MW1126	METHANE	W	40V	2
X21365E-G	TW-1110D	METHANE	W	40V	2
X21366E-G	MW1119	METHANE	W	40V	2
X21367E-G	MW1109	METHANE	W	40V	2
X21368E-G	*MW1110	METHANE	W	40V	2
X21369E-G	MW-1104	METHANE	W	40V	2

P-Sample to be returned

to GC/MS ___ GC X Metals ___ Wet Chem X HPLC ___ SxPrep ___

T

SxRec C QA/QC C Acctg C File Orig

Custodian/Date: DKB 4/5/96
Dm 4/5/96

Lab ID #	Client ID#	Analysis	Mtx	Btl	Loc
X21371E-G	TW-1106	METHANE	W	40V	2
X21372E-G	TW-1102	METHANE	W	40V	2
X21373E-G	TW-1111	METHANE	W	40V	2
X21377E-G	ESMP-6D	METHANE	W	40V	2
X21362H	MW-1122	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21363H	MW-1121	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21364H	MW-1126	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21365H	TW-1110D	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21366H	MW-1119	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21367H	MW-1109	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21368H	*MW-1110	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21369H	MW-1104	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21371H	TW-1106	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21372H	TW-1102	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21373H	TW-1111	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21377H	ESMP-6D	NO_2, NO_3, SO_4, Cl^-	W	125P	E6
X21368I	MW-1110	ALKALINITY	W	125P	E6
X21368J	MW-1110	TOC	W	125A	E6
X21370A	MW-1105	BTEX	PRODUCT	40V	10
X21370B	MW-1105	DENSITY	PRODUCT	40V	10
X21374A	ESS4-9'-10'	TOC (% MOISTURE)	S	4WM	OUT
X21375A	ESS18-9.0'-9.5'	TOC (% MOISTURE)	S	4WM	OUT

Project # 96-0955

R=Sample to be returned

CHAIN OF CUSTODY RECORD / NALYTICAL SERVICES REQUEST

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 2

COMPANY Parsons Engineering Science
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Todd Herrington
PROJECT I.D. Eaker AFB, 722450150020
EAL. QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Shin Ozaki, Mark Vessely, Todd Herrington
(print) [illegible]
Evergreen Analytical Cooler No. 604
Cooler Received ______

Please **PRINT** all information:

EAL use only — Do not write in shaded area
EAL Project # 96-0955
Custodian MJM

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	Soil / Solid	Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	~~TEPH 8015mod. (Diesel)~~ Methane	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Anions (NO2, NO3, SO4, Cl)	Alkalinity	TOC	Density	EAL Sample No.
MW1122	3-26-96	4:50pm	8	X										X		X	X			X				X21362
MW1121	3-26-96	16:45	8	X										X		X	X			X				63
MW1136	3-26-96	17:00	8	X										X		X	X			X				64
TW-1110D	3-27-96	9:00	8	X										X		X	X			X				65
MW-1119	3-27-96	8:08	8	X										X		X	X			X				66
MW-1109	3-27-96	9:30	8	X										X		X	X			X				67
MW-1110	3-27-96	8:40	10	X			(labelled as TW-1110)							X		X	X			X	X	X		68
MW-1104	3-27-96	10:00	8	X										X		X	X			X				69
MW-1105	3-27-96	9:40	2			X							VOA	X									X	70A/B #10
TW-1106	3-27-96	11:00	8	X										X		X	X			X				71
HT:														A/B		C/D	E-G			H	I	J		Location 2,E6
DD:														40V		40V	40V			125P	125P	1LM		Container Size

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Shin Ozaki	3/27/96 16:00	FEDEX	3/27 16:00			[illegible]	3/28/96 1000

CHAIN OF CUSTODY RECORD ANALYTICAL SERVICES REQUEST

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 2 of 2

COMPANY Parsons Engineering Science
ADDRESS 1700 Broadway Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Todd Herrington
PROJECT I.D. Baker AFB, 722450150020
EAL. QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day)
☐ Other (Specify) ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) [signature]
(print) [illegible]
Evergreen Analytical Cooler No. 6C4
Cooler Received ______

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL Project # 96-0955
Custodian MJM

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	Soil / Solid	Oil / Sludge	ANALYSIS REQUESTED: TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	~~TEPH 8015mod. (Diesel)~~ Methane	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Cl, NO3, SO4	Alkalinity	TOC					EAL Sample No.
TW 1102	3-27-96	14:00	8	X										X		X	X			X							X21372
MW 11W111	3-27-96	14:20	8	X										X		X	X			X							73
ES54-9'-10'	3-27-96	13:30	1		X																X						74 A
ES51B-9.0'-9.5'	3-27-96	14:15	1		X																X						75 A
Trip Blank	3-27-96	—	1											X		X	X										76 A
ES11P-6D	3-27-96	15:15	8	X										X		X	X			X							77
HT:														NB		CIA	E-G			H							Location 2, E6
DD:														40V		40V	40V			125 P	4W m						Container Size 1

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	3/27 16:00	FEDEX	3/27/96			[signature]	3/28/96 1000

Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3/28/96 1000 Shipped Via: Fed-X 722-1153741
(Airbill # if applicable)

Client : Parsons ES

Client Project ID(s): Eaker AFB 722450.15020

EAL Project #(s): 96- 0955 EAL Cooler(s): Y N

Cooler#	604				
Ice packs	Y N	Y N	Y N	Y N	Y N
Temperature °C	8.12				

	Y	N	N/A
1. Custody seal(s) present:		X	
Seals on cooler intact			X
Seals on bottle intact			X
2. Chain of Custody present:	X		
3. Samples Radioactive: (Comment on COC if >0.5mr/h)		X	
4. Containers broken or leaking: (Comment on COC if Y)		X	
5. Containers labeled:	X		
6. COC agrees w/ bottles received: (Comment on COC if N)	~~X~~ pm	X	
7. COC agrees w/ labels: (Comment on COC if N)		X	
8. Headspace in vials-waters only: (Comment on COC if Y)		X	
9. VOA samples preserved:	X		
10. pH measured on metals, cyanide or phenolics*:			X

List discrepancies

*Non-EAL provided containers only, water samples only.

	Y	N
11. Metal samples present:		X
Total ____ , Dissolved ____ , TCLP ____		
D or PD to be filtered:		
T,TR,D,PD to be Preserved:		
12. Short holding times:	X	
Specify parameters NO2/NO3		
13. Multi-phase sample(s) present:		X
14. COC signed w/ date/time:	X	

Comments: #6. Sample bottles were received for Methane analysis, not indicated on C.O.C.

(Additional comments on back)

Custodian Signature/Date: MM 3/28/96

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Everg Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY arsons Engineering Science
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Todd Herrington
PROJECT I.D. Eaker AFB, 722450150?0
EAL. QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify)______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Shin Ozaki, Mike Vessely, Todd Herrington
(print) [illegible]
Evergreen Analytical Cooler No. 604
Cooler Received______

Please **PRINT** all information:

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Anions (NO2, NO3, SO4, Cl)	Alkalinity	TOC	Density			EAL Sample No.
MW1122	3-26-96	4:35pm	8	X										X		X				X						
MW1121	3-26-96	1645	3	X										X		X				X						
MW1136	3-26-96	17:00	3	X										X		X				X						
TW-1110D	3-27-96	9:00	8	X										X		X				X						
MW-1119	3-27-96	8:00	8	X										X		X				X						
MW-1109	3-27-96	9:30	8	X										X		X				X						
MW-1110	3-27-96	8:40	10	X										X		X				X	X	X				
MW-1104	3-27-96	10:00	8	X										X		X				X						
MW-1105	3-27-96	9:40	2			X								X									X			
TW-1106	3-27-96	11:??	3	X										X		X				X						
HT:																										Location
DD:																										Container Size

EAL use only
Do not write in shaded area
EAL Project #______
Custodian______

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	3/27/96	FEDEX	3/27 16:00			[signature]	3/28/96 1000

CHAIN OF CUSTODY RECORD NALYTICAL SERVICES REQUEST

Everg Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 2 of 2

COMPANY Parsons Engineering Science
ADDRESS 1700 Broadway Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Todd Herrington
PROJECT I.D. Baker AFB, 722450150020
EAL. QUOTE # ____ P.O.# ____
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ____
*expedited turnaround subject to additional fee

Sampler Name:
(signature) [illegible] Sushinski
(print) Shin Sushinski, M. Vasicky

Evergreen Analytical Cooler No. 604
Cooler Received ____

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL
Project # ____
Custodian ____

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil/Solid	MATRIX: Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Cl, NO2, NO3, SO4	Alkalinity	TOC					EAL Sample No.
TW 1102	3-27-96	14:00	8	X										X		X				X							
MW 1111	3-27-96	14:20	3	X										X		X				X							
ESS4 - 9'-10'	3-27-96	13:30	1		X																	X					
ESS18 - 9.0'-9.5'	3-27-96	14:45	1		X																	X					
Trip Blank	3-27-96	—	1	X										X		X											
ESS11P - 6D	3-27-96	15:15	8	X										X		X				X							

HT: Location
DD: Container Size

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[illegible]	3/27	FEDEX	3/27/96			[illegible]	3/28/96 1100

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MEB1040196B	Client Project Number	: 722450.15020
Date Prepared	: 4/1/96	Lab Project Number	: 96-0955
Dilution Factor	: 50	Matrix	: MEOH
		Lab File Number	: TVBX0401023

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	mg/kg
Benzene	71-43-2	4/2/96	U	20	ug/kg
Toluene	108-88-3	4/2/96	U	20	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	20	ug/kg
Ethyl Benzene	100-41-4	4/2/96	U	20	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	U	20	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	20	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	20	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	20	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	25	ug/kg
FID Surrogate Recovery:	NA			50%-132%	(Limits)
PID Surrogate Recovery:		103%		72%-118%	(Limits)

s: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

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Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB032896	Client Project Number	: 722450.15020
Date Prepared	: 3/28/96	Lab Project Number	: 96-0955
Dilution Factor	: 1.0	Matrix	: WATER
		Lab File Number	: TVBX0328016

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/28/96	U	0.1	mg/L
Benzene	71-43-2	3/28/96	U	0.4	ug/L
Toluene	108-88-3	3/28/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/28/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/28/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/28/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/28/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/28/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/28/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/28/96	U	0.5	ug/L
FID Surrogate Recovery:		96%		70%-130%	(Limits)
PID Surrogate Recovery:		94%		70%-128%	(Limits)

N[illegible] Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB040196	Client Project Number	: 722450.15020
Date Prepared	: 4/1/96	Lab Project Number	: 96-0955
Dilution Factor	: 1.0	Matrix	: WATER
		Lab File Number	: TVBX0330061

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	U	0.1	mg/L
Benzene	71-43-2	4/1/96	U	0.4	ug/L
Toluene	108-88-3	4/1/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	0.5	ug/L
FID Surrogate Recovery:		98%		70%-130%	(Limits)
ID Surrogate Recovery:		96%		70%-128%	(Limits)

es: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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TVBP0955.XLS; 4/2/96; 1

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Methods 602/8020 and 5030/8015 Modified Data Report

ent Sample Number	: MW 1122	Client Project Number	: 722450.15020
Lab Sample Number	: X21362	Lab Project Number	: 96-0955
Date Sampled	: 3/26/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0328023
Date Prepared	: 3/28/96	Method Blank	: MB032896
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	U	0.1	mg/L
Benzene	71-43-2	3/29/96	U	0.4	ug/L
Toluene	108-88-3	3/29/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	U	0.5	ug/L
ID Surrogate Recovery:		96%		70%-130%	(Limits)
Surrogate Recovery:		93%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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TVBP0955.XLS; 4/2/96; 2

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MW 1121	Client Project Number	: 722450.15020
Lab Sample Number	: X21363	Lab Project Number	: 96-0955
Date Sampled	: 3/26/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0328024
Date Prepared	: 3/28/96	Method Blank	: MB032896
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	U	0.1	mg/L
Benzene	71-43-2	3/29/96	U	0.4	ug/L
Toluene	108-88-3	3/29/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	U	0.5	ug/L
FID Surrogate Recovery:		94%		70%-130%	(Limits)
PID Surrogate Recovery:		94%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MW 1126	Client Project Number	: 722450.15020
Lab Sample Number	: X21364	Lab Project Number	: 96-0955
Date Sampled	: 3/26/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0328025
Date Prepared	: 3/28/96	Method Blank	: MB032896
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	U	0.1	mg/L
Benzene	71-43-2	3/29/96	U	0.4	ug/L
Toluene	108-88-3	3/29/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	U	0.5	ug/L
FID Surrogate Recovery:		92%		70%-130%	(Limits)
PID Surrogate Recovery:		89%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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TVBP0955.XLS; 4/2/96; 4

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

ent Sample Number	: MW-1119	Client Project Number	: 722450.15020
Lab Sample Number	: X21366	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0328028
Date Prepared	: 3/28/96	Method Blank	: MB032896
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	1.1	0.1	mg/L
Benzene	71-43-2	3/29/96	U	0.4	ug/L
Toluene	108-88-3	3/29/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	U	0.5	ug/L
iD Surrogate Recovery:		93%		70%-130%	(Limits)
Surrogate Recovery:		88%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

nt Sample Number	: MW-1109	Client Project Number	: 722450.15020
Lab Sample Number	: X21367	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0330065
Date Prepared	: 3/31/96	Method Blank	: MB040196
FID Dilution Factor	: 50		
PID Dilution Factor	: 50		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	13	5.0	mg/L
Benzene	71-43-2	4/1/96	2600	20	ug/L
Toluene	108-88-3	4/1/96	62	20	ug/L
Chlorobenzene	108-90-7	4/1/96	U	20	ug/L
Ethyl Benzene	100-41-4	4/1/96	170	20	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	790	20	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	20	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	200	20	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	64	20	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	44	25	ug/L
ID Surrogate Recovery:		101%		70%-130%	(Limits)
Surrogate Recovery:		100%		70%-128%	(Limits)

otes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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TVBP0955.XLS; 4/2/96; 7

EVERGREEN ANALYTICAL, INC.
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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

ent Sample Number	: TW-1110D	Client Project Number	: 722450.15020
Lab Sample Number	: X21365	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0330062
Date Prepared	: 3/31/96	Method Blank	: MB040196
FID Dilution Factor	: 100		
PID Dilution Factor	: 100		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	22	10	mg/L
Benzene	71-43-2	4/1/96	6300	40	ug/L
Toluene	108-88-3	4/1/96	140	40	ug/L
Chlorobenzene	108-90-7	4/1/96	U	40	ug/L
Ethyl Benzene	100-41-4	4/1/96	620	40	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	440	40	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	40	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	61	40	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	40	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	63	50	ug/L
ID Surrogate Recovery:		101%		70%-130%	(Limits)
Surrogate Recovery:		100%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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TVBP0955.XLS; 4/2/96; 5

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

nt Sample Number	: MW-1110	Client Project Number	: 722450.15020
Lab Sample Number	: X21368	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0330063
Date Prepared	: 3/31/96	Method Blank	: MB040196
FID Dilution Factor	: 100		
PID Dilution Factor	: 100		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	27	10	mg/L
Benzene	71-43-2	4/1/96	5900	40	ug/L
Toluene	108-88-3	4/1/96	230	40	ug/L
Chlorobenzene	108-90-7	4/1/96	U	40	ug/L
Ethyl Benzene	100-41-4	4/1/96	520	40	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	510	40	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	40	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	70	40	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	40	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	50	ug/L
ID Surrogate Recovery:		101%		70%-130%	(Limits)
urrogate Recovery:		100%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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TVBP0955.XLS; 4/12/96; 8

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	MW-1104	Client Project Number	:	722450.15020
Lab Sample Number	:	X21369	Lab Project Number	:	96-0955
Date Sampled	:	3/27/96	Matrix	:	WATER
Date Received	:	3/28/96	Lab File Number(s)	:	TVBX0328036
Date Prepared	:	3/28/96	Method Blank	:	MB032896
FID Dilution Factor	:	1.0			
PID Dilution Factor	:	1.0			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	2.0	0.1	mg/L
Benzene	71-43-2	3/29/96	50	0.4	ug/L
Toluene	108-88-3	3/29/96	20	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	38	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	97	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	15	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	36	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	11	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	14	0.5	ug/L
FID Surrogate Recovery:		96%		70%-130%	(Limits)
PID Surrogate Recovery:		91%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

nt Sample Number	: MW-1105	Client Project Number	: 722450.15020
Lab Sample Number	: X21370	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: OIL
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0401024,38
Date Prepared	: 4/1,2/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 1,000,000		
PID Dilution Factor	: 50,000 & 1,000,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/2/96	10,000,000	400,000	ug/kg
Toluene	108-88-3	4/2/96	65,000,000	400,000	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	20,000	ug/kg
Ethyl Benzene	100-41-4	4/2/96	13,000,000	400,000	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	66,000,000	400,000	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	8,400,000	400,000	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	26,000,000	400,000	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	7,500,000	400,000	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	3,600,000	20,000	ug/kg
ID Surrogate Recovery:		NA		50%-132%	(Limits)
urrogate Recovery:		105%,100%		72%-118%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

TVBP0955.XLS; 4/2/96; 10

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: TW-1106	Client Project Number	: 722450.15020
Lab Sample Number	: X21371	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0328029
Date Prepared	: 3/28/96	Method Blank	: MB032896
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	U	0.1	mg/L
Benzene	71-43-2	3/29/96	U	0.4	ug/L
Toluene	108-88-3	3/29/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	U	0.5	ug/L
FID Surrogate Recovery:		90%		70%-130%	(Limits)
[illegible] Surrogate Recovery:		88%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

[signature]
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TVBP0955.XLS; 4/2/96; 11

EVERGREEN ANALYTICAL, INC.
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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

ent Sample Number	: TW 1102	Client Project Number	: 722450.15020
Lab Sample Number	: X21372	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0328030
Date Prepared	: 3/28/96	Method Blank	: MB032896
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	0.3	0.1	mg/L
Benzene	71-43-2	3/29/96	0.4	0.4	ug/L
Toluene	108-88-3	3/29/96	3.2	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	0.5	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	3.0	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	0.5	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	1.6	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	0.8	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	U	0.5	ug/L
ID Surrogate Recovery:		95%		70%-130%	(Limits)
Surrogate Recovery:		91%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

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TVBP0955.XLS; 4/2/96; 12

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Methods 602/8020 and 5030/8015 Modified Data Report

nt Sample Number	: TW 1111	Client Project Number	: 722450.15020
Lab Sample Number	: X21373	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0330064
Date Prepared	: 3/31/96	Method Blank	: MB040196
FID Dilution Factor	: 100		
PID Dilution Factor	: 100		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	58	10	mg/L
Benzene	71-43-2	4/1/96	2300	40	ug/L
Toluene	108-88-3	4/1/96	4500	40	ug/L
Chlorobenzene	108-90-7	4/1/96	U	40	ug/L
Ethyl Benzene	100-41-4	4/1/96	1400	40	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	8800	40	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	530	40	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	1700	40	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	5300	40	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	160	50	ug/L
FID Surrogate Recovery:		102%		70%-130%	(Limits)
Surrogate Recovery:		100%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

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TVBP0955.XLS; 4/2/96; 13

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

nt Sample Number	: TRIP BLANK	Client Project Number	: 722450.15020
Lab Sample Number	: X21376	Lab Project Number	: 96-0955
Date Sampled	: NA	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0328022
Date Prepared	: 3/28/96	Method Blank	: MB032896
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	U	0.1	mg/L
Benzene	71-43-2	3/29/96	U	0.4	ug/L
Toluene	108-88-3	3/29/96	U	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	U	0.5	ug/L
FID Surrogate Recovery:		93%		70%-130%	(Limits)
Surrogate Recovery:		92%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP-6D	Client Project Number	: 722450.15020
Lab Sample Number	: X21377	Lab Project Number	: 96-0955
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/28/96	Lab File Number(s)	: TVBX0328031
Date Prepared	: 3/28/96	Method Blank	: MB032896
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	3/29/96	U	0.1	mg/L
Benzene	71-43-2	3/29/96	U	0.4	ug/L
Toluene	108-88-3	3/29/96	1.1	0.4	ug/L
Chlorobenzene	108-90-7	3/29/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/29/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	3/29/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	3/29/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	3/29/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	3/29/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	3/29/96	U	0.5	ug/L
FID Surrogate Recovery:		93%		70%-130%	(Limits)
PID Surrogate Recovery:		90%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

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TVBP955B.XLS; 4/2/96; 3

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	: TW 1106	Client Project No.	: 722450.15020
Lab Sample No.	: X21371	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	EPA Method No.	: 602/8020
Date Received	: 3/28/96	Matrix	: Water
Date Prepared	: 3/31/96	Lab File Number(s)	: TVBX0330057,58
Date Analyzed	: 4/1/96	Method Blank	: MB033196
		Dilution Factor	: 1.0

Compound	Spike Added (ug/L)	Sample Concentration (ug/L)	Concentration (ug/L)		Comments
			MS	MSD	
Benzene	20.0	0.0	20.9	20.4	
Toluene	20.0	0.0	19.3	18.7	
Chlorobenzene	20.0	0.0	19.0	19.1	
Ethylbenzene	20.0	0.0	19.4	19.3	
m,p-Xylene	20.0	0.0	20.1	19.9	
o-Xylene	20.0	0.0	19.0	19.2	
1,3,5-TMB	20.0	0.0	19.0	18.7	
1,2,4-TMB	20.0	0.0	19.0	18.1	
1,2,3-TMB	20.0	0.0	18.9	18.9	
1,2,3,4-TeMB	20.0	0.0	19.4	19.4	
Surrogate	100.0	87%	103%	101%	% RECOVERY

Compound		MS % RECOVERY	MSD % RECOVERY	RPD	QC# Limits	
					RPD	%REC
Benzene		104.5	102.0	2.4	25	50 - 150
Toluene		96.5	93.5	3.2	25	50 - 148
Chlorobenzene		95.0	95.5	0.5	25	55 - 135
Ethylbenzene		97.0	96.5	0.5	25	50 - 150
m,p-Xylene		100.5	99.5	1.0	25	50 - 150
o-Xylene		95.0	96.0	1.0	25	50 - 150
1,3,5-TMB		95.0	93.5	1.6	25	50 - 150
1,2,4-TMB		95.0	90.5	4.9	25	50 - 150
1,2,3-TMB		94.5	94.5	0.0	25	50 - 150
1,2,3,4-TeMB		97.0	97.0	0.0	25	50 - 150
Surrogate		103.0	101.0	NA	NA	70 - 128

= Values taken from EPA methods 602/8020.
* = Values outside of QC limits.

RPD: 0 out of (10) outside limits.
Spike Recovery: 0 out of (20) outside limits.

Comments:

K. Hollman
Analyst

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MBP0955A.XLS; 4/1/96

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
TVH Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	: MW 1126	Client Project No.	: 722450,15020
Lab Sample No.	: X21364	Lab Project No.	: 96-0955
Date Sampled	: 3/26/96	EPA Method No.	: 5030/8015 Modified
Date Received	: 3/28/96	Matrix	: WATER
Date Prepared	: 3/31/96	Lab File Number(s)	: TVBX0330055,56
Date Analyzed	: 4/1/96	Method Blank	: MB033196
		Dilution Factor	: 1.0

Compound	Spike Added (mg/L)	Sample Concentration (mg/L)	MS Concentration (mg/L)	MS %REC	QC*** Limits %REC
Gasoline	2.00	0.00	2.15	107.5%	57-126
Surrogate **	---	---	---	103%	70-128

Compound	Spike Added (mg/L)	MSD Concentration (mg/L)	MSD %REC	RPD	QC*** Limits	
					RPD	%REC
Gasoline	2.00	2.08	104.0%	3.3	28.2	57-126
Surrogate **	---	---	102%	NA	NA	70-128

RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

Notes:
NA = Not analyzed/not applicable.
* = Value outside of QC limits.
** = 1,2,4-Trichlorobenzene
*** =Limits established 3/8/96. KSH

Comments:

K. Hollman
Analyst

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MTP0955B.XLS; 4/1/96; 2:59 PM

EVERGREEN ANALYTICAL, INC.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
Laboratory Control Sample (LCS)

LCS Number	: LCS040196-GW	Matrix	: WATER
Date Prepared	: 4/1/96	Method Numbers	: EPA 5030/8015 Modified
Date Analyzed	: 4/2/96		
Lab File Number(s)	: TVBX0401014		

Compound Name	Theoretical Concentration (mg/L)	LCS Concentration (mg/L)	LCS % Recovery	QC Limit** % Recovery
Gasoline	2.00	2.35	117.5	78 - 137
Surrogate Recovery:		103%		70 - 130

QUALIFIERS
B = TVH as Gasoline found in blank also.
E = Extrapolated value. Value exceeds calibration range.
NA = Not Available/Not Applicable.
** = Limits established 3/11/96 for TVHBTEX2. KSH

K. Hollman
Analyst

McClelle
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form
Method Blank Report

Method Blank Number	: GB040496	Client Project No.	: 722450.15020
Date Extracted/Prepared	: 4/4/96	Lab Project No.	: 96-0955
Date Analyzed	: 4/4/96	Dilution Factor	: 1.00
		Method	: RSKSOP-175
		Matrix	: Water
		Lab File No.	: GAS0404002

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0955.XLS

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

[redacted] Sample Number	: MW1122	Client Project No.	: 722450.15020
Lab Sample Number	: X21362	Lab Project No.	: 96-0955
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404007

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

nperature	: 70.5 F	Saturation Concentration	Meth 0
. [redacted]nt Injected	: 0.5 ml		
T[redacted]olume of Sample	: 43 ml	Concentration in Head Space	Meth 0
He[redacted] space created	: 4 ml		
Methane Area	: 0 ug		

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

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AF0955.XLS

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(303) 425-6021

Methane Report Form

[redacted]Sample Number	: MW1121	Client Project No.	: 722450.15020
Lab Sample Number	: X21363	Lab Project No.	: 96-0955
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404008

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

mperature	: 69 F	Saturation Concentration	Meth	0
[redacted]nt Injected	: 0.5 ml			
T[redacted]olume of Sample	: 43 ml	Concentration in Head Space	Meth	0
He[redacted]space created	: 4 ml			
Methane Area	: 0 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted] Analyst

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AF0955.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

[redacted] Sample Number	: MW1126	Client Project No.	: 722450.15020
[redacted]Sample Number	: X21364	Lab Project No.	: 96-0955
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404009

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.006	0.002

[redacted]mperature	: 69.1 F	Saturation	Meth	0.001387172
[redacted]ount Injected	: 0.5 ml	Concentration		
[redacted]olume of Sample	: 43 ml	Concentration	Meth	0.004394657
H[redacted]space created	: 4 ml	in Head Space		
Methane Area	: 32.258 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

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AF0955.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

[redacted]Sample Number	: MW1126	Client Project No.	: 722450.15020
Lab Sample Number	: X21364Dup	Lab Project No.	: 96-0955
Date Sampled	: 3/26/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404010

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.005	0.002

mperature	: 69.2 F	Saturation Concentration	Meth	0.001188329
[redacted]nt Injected	: 0.5 ml			
[redacted]olume of Sample	: 43 ml	Concentration in Head Space	Meth	0.003763995
He[redacted] space created	: 4 ml			
Methane Area	: 27.634 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

Approved

AF0955.XLS

EVERGREEN ANALYTICAL, INC.
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(303) 425-6021

Methane Report Form

C[redacted]ample Number	: MW-1119	Client Project No.	: 722450.15020
Lab Sample Number	: X21366	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404012

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.092	0.002

Temperature	: 70.5 F	Saturation	Meth	0.022030828
[redacted]nt Injected	: 0.5 ml	Concentration		
T[redacted]olume of Sample	: 43 ml	Concentration	Meth	0.069610779
He[redacted]space created	: 4 ml	in Head Space		
Methane Area	: 512.316 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0955.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Sample Number	: MW-1109	Client Project No.	: 722450.15020
Lab Sample Number	: X21367	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	Dilution Factor	: 10.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404013

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	1.00	0.02

mperature	: 72.2 F	Saturation Concentration	Meth	0.240513832
nt Injected	: 0.05 ml			
olume of Sample	: 43 ml	Concentration in Head Space	Meth	0.757520993
He space created	: 4 ml			
Methane Area	: 559.303 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

[redacted] Sample Number	:	MW-1110	Client Project No.	:	722450.15020
Lab Sample Number	:	X21368	Lab Project No.	:	96-0955
Date Sampled	:	3/27/96	Dilution Factor	:	50.00
Date Received	:	3/28/96	Method	:	RSKSOP-175
Date Extracted/Prepared	:	4/4/96	Matrix	:	Water
Date Analyzed	:	4/4/96	Lab File No.	:	GAS0404014

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	2.6	0.1

Temperature	:	73.9 F	Saturation	Meth	0.638633259
[redacted]nt Injected	:	0.01 ml	Concentration		
[redacted]olume of Sample	:	43 ml	Concentration	Meth	2.005023814
[redacted] space created	:	4 ml	in Head Space		
Methane Area	:	297.022 ug			
Atomic weight(Methane)	:	16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

[redacted] Sample Number	: TW-1110D	Client Project No.	: 722450.15020
Lab Sample Number	: X21365	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404011

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.045	0.002

Temperature	: 68.8 F	Saturation	Meth	0.010776966
[redacted]nt Injected	: 0.5 ml	Concentration		
T[redacted]olume of Sample	: 43 ml	Concentration	Meth	0.03416156
He[redacted] space created	: 4 ml	in Head Space		
Methane Area	: 250.613 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

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Methane Report Form

Sample Number	:	MW-1104	Client Project No.	:	722450.15020
Lab Sample Number	:	X21369	Lab Project No.	:	96-0955
Date Sampled	:	3/27/96	Dilution Factor	:	1.00
Date Received	:	3/28/96	Method	:	RSKSOP-175
Date Extracted/Prepared	:	4/4/96	Matrix	:	Water
Date Analyzed	:	4/4/96	Lab File No.	:	GAS0404016

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.036	0.002

Temperature	:	74.6 F	Saturation Concentration	Meth	0.008787373
unt Injected	:	0.5 ml			
Volume of Sample	:	43 ml	Concentration in Head Space	Meth	0.02755227
space created	:	4 ml			
Methane Area	:	204.346 ug			
Atomic weight(Methane)	:	16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

[redacted] Sample Number	: TW-1106	Client Project No.	: 722450.15020
La[redacted] Sample Number	: X21371	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404017

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.004	0.002

Temperature	:	73.7 F
Amount Injected	:	0.5 ml
T[redacted]olume of Sample	:	43 ml
He[redacted]space created	:	4 ml
Methane Area	:	22.346 ug
Atomic weight(Methane)	:	16 g

Saturation Concentration	Meth	0.000960932
Concentration in Head Space	Meth	0.00301803

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Sample Number	: TW1102	Client Project No.	: 722450.15020
Lab Sample Number	: X21372	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404018

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	:	71.8 F
Amount Injected	:	0.5 ml
Total Volume of Sample	:	43 ml
Head space created	:	4 ml
Methane Area	:	0.44 ug
Atomic weight(Methane)	:	16 g

Saturation Concentration	Meth	1.89211E-05
Concentration in Head Space	Meth	5.96386E-05

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

[redacted] Sample Number	: TW1111	Client Project No.	: 722450.15020
La[redacted]ample Number	: X21373	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404019

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.091	0.002

Temperature	: 71.7 F	Saturation Concentration	Meth	0.021908186
[redacted]ount Injected	: 0.5 ml			
[redacted]olume of Sample	: 43 ml	Concentration in Head Space	Meth	0.069066857
[redacted]space created	: 4 ml			
Methane Area	: 509.464 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
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(303) 425-6021

Methane Report Form

[redacted] Sample Number	: ESMP-6D	Client Project No.	: 722450.15020
Lab Sample Number	: X21377	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	Dilution Factor	: 1.00
Date Received	: 3/28/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Lab File No.	: GAS0404020

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.007	0.002

mperature	: 71.5 F	Saturation	Meth	0.001602872
[redacted]unt Injected	: 0.5 ml	Concentration		
[redacted]olume of Sample	: 43 ml	Concentration	Meth	0.005055054
[redacted] space created	: 4 ml	in Head Space		
Methane Area	: 37.274 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

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(303) 425-6021

RSKSOP-175 Gas Method
Methane, Ethane, Ethene Gas Matrix Spike / Matrix Spike Duplicate Report

Client Sample No.	: MW-1119	Client Project No.	: 722450.15020
Lab Sample No.	: X21366	Lab Project No.	: 96-0955
Date Sampled	: 3/27/96	EPA Method No.	: RSKSOP-175
Date Received	: 3/28/96	Matrix	: Water
Date Prepared	: 4/4/96	Method Blank	: GB040496
Date Analyzed	: 4/4/96	Lab File No's.	: GAS0404021,022
E.A. MS/MSD Spike Source No.	: 1723		

Compound	Spike Added (ug)	Sample Concentration (ug)	MS Concentration (ug)	MS %REC	QC Limits %REC
Methane Gas	500	51	336	57	40-89

Compound	Spike Added (ug)	MSD Concentration (ug)	MSD %REC	RPD	QC Limits RPD	QC Limits %REC
Methane Gas	500	340	58	1.0	0-24.4	40-89

RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available

Note: The Spike was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

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MS0955.XLS; 4/4/96

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(303) 425-6021

RSK-175 Gas Method
Methane LCS Report Form

LCS No.	: LCS040496	EPA Method No.	: RSKSOP-175
Date Prepared	: 4/4/96	Matrix	: Water
Date Analyzed	: 4/4/96	Method Blank	: GB040496
E.A. LCS Source No.	: 1723	Lab File No.	: GAS0404006

Compound	Spike Added (ug)	Method Blank Concentration (ug)	LCS Concentration (ug)	LCS %REC	QC Limits %REC
Methane Gas	500	0	405	81	67-85

Spike Recovery: 0 out of (1) outside limits.

Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

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LCS0404.XLS; 4/4/96

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/26-27/96	Client Project ID.	: 722450.15020
Date Received	: 3/28/96	Lab Project Number	: 96-0955
Date Prepared	: 3/28/96	Method	: EPA 300.0
Date Analyzed	: 3/28/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Chloride mg/L	Dilution Factor
X21362	MW-1122	Water	5.7	1
X21363	MW-1121	Water	4.7	1
X21364	MW-1126	Water	7.3	1
X21365	TW-1110D	Water	206	10
X21366	MW-1119	Water	12.1	1
X21367	MW-1109	Water	40.2	10
X21368	MW-1110	Water	201	10
X21369	MW-1104	Water	10.1	1
X21371	TW-1106	Water	4.6	1
X21372	TW-1102	Water	8.8	1
X21373	TW-1111	Water	6.0	1
X21377	ESMP-6D	Water	10.3	1
Method Blank	(3/28/96)		<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21242 (96-0928)	Matrix Spike	10.0	4.2	12.2	80
X21242 (96-0928)	Matrix Spike Dup	10.0	4.2	12.4	82
MS/MSD RPD					3.0

Analyst

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(303) 425-6021

Anion Report

Date Sampled	: 3/26-27/96		Client Project ID.	: 722450.15020
Date Received	: 3/28/96		Lab Project Number	: 96-0955
Date Prepared	: 3/28/96		Method	: EPA 300.0
Date Analyzed	: 3/28/96		Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
X21362	MW-1122	Water	<0.076	1
X21363	MW-1121	Water	<0.076	1
X21364	MW-1126	Water	<0.076	1
X21365	TW-1110D	Water	<0.76**	10
X21366	MW-1119	Water	<0.076	1
X21367	MW-1109	Water	<0.076	1
X21368	MW-1110	Water	<0.76**	10
X21369	MW-1104	Water	<0.076	1
X21371	TW-1106	Water	<0.076	1
X21372	TW-1102	Water	<0.076	1
X21373	TW-1111	Water	<0.076	1
X21377	ESMP-6D	Water	<0.076	1
Method Blank	(3/28/96)		<0.076	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21242 (96-0928)	Matrix Spike	10.0	<0.25	9.2	92
X21242 (96-0928)	Matrix Spike Dup	10.0	<0.25	9.1	91
MS/MSD RPD					0.8

* = Quality assurance results reported as Nitrite (NO_2).

** = Increased detection limit due to matrix interference.

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/26-27/96		Client Project ID.	:	722450.15020
Date Received	: 3/28/96		Lab Project Number	:	96-0955
Date Prepared	: 3/28/96		Method	:	EPA 300.0
Date Analyzed	: 3/28/96		Detection Limit	:	0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
X21362	MW-1122	Water	0.12	1
X21363	MW-1121	Water	0.43	1
X21364	MW-1126	Water	<0.056	1
X21365	TW-1110D	Water	<0.056	1
X21366	MW-1119	Water	0.058	1
X21367	MW-1109	Water	<0.056	1
X21368	MW-1110	Water	<0.056	1
X21369	MW-1104	Water	0.058	1
X21371	TW-1106	Water	0.070	1
X21372	TW-1102	Water	0.074	1
X21373	TW-1111	Water	0.065	1
X21377	ESMP-6D	Water	0.12	1
Method Blank	(3/28/96)		<0.056	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21242 (96-0928)	Matrix Spike	10.0	<0.25	9.0	90
X21242 (96-0928)	Matrix Spike Dup	10.0	<0.25	8.9	89
MS/MSD RPD					0.6

* = Quality assurance results reported as Nitrate (NO_3).

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Anion Report

Date Sampled	: 3/26-27/96		Client Project ID.	:	722450.15020
Date Received	: 3/28/96		Lab Project Number	:	96-0955
Date Prepared	: 3/28/96		Method	:	EPA 300.0
Date Analyzed	: 3/28/96		Detection Limit	:	0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
X21362	MW-1122	Water	27.2	1
X21363	MW-1121	Water	15.9	1
X21364	MW-1126	Water	26.2	1
X21365	TW-1110D	Water	1.5	1
X21366	MW-1119	Water	70.5	10
X21367	MW-1109	Water	15.4	1
X21368	MW-1110	Water	1.5	1
X21369	MW-1104	Water	21.6	1
X21371	TW-1106	Water	14.6	1
X21372	TW-1102	Water	38.4	1
X21373	TW-1111	Water	1.5	1
X21377	ESMP-6D	Water	80.4	10
Method Blank	(3/28/96)		<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21242 (96-0928)	Matrix Spike	10.0	10.0	18.8	88
X21242 (96-0928)	Matrix Spike Dup	10.0	10.0	18.6	86
MS/MSD RPD					2.2

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(303) 425-6021

Analysis Report

Date Sampled	: 3/27/96	Client Project ID.	: 72245015020
Date Received	: 3/28/96	Lab Project Number	: 96-0955
Date Prepared	: 4/1/96	Method	: EPA 310.1
Date Analyzed	: 4/1/96	Detection Limit	: 5.0 mg $CaCO_3/L$

Evergreen Sample #	Client Sample ID.	Matrix	Total Alkalinity (mg $CaCO_3/L$)	Dilution Factor
X21368	MW-1110	Water	436	1
Method Blank	(4/1/96)		<5.0	

Quality Assurance

Reference	True Value (mg$CaCO_3/L$)	Result (mg$CaCO_3/L$)	% Recovery
ERA Alkalinity Lot # 0814-95-02	120	125	104

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(303) 425-6021

Analysis Report

Date Sampled	: 3/27/96	Client Project ID.	: 72245015020
Date Received	: 3/28/96	Lab Project Number	: 96-0955
Date Prepared	: 4/2/96	Matrix	: Product
Date Analyzed	: 4/2/96	Method	: ASTM D287

Evergreen Sample #	Client Sample ID.	Density (g/cc) @ 60 °F
X21370	MW-1105	0.7650

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Total Organic Carbon

Date Sampled	: 3/27/96		Client Project ID.	:	72245015020
Date Received	: 3/28/96		Lab Project Number	:	96-0955
Date Prepared	: 4/1/96		Method	:	EPA 415.1
Date Analyzed	: 4/1/96		Detection Limit	:	1.0 mg C/L

Evergreen Sample #	Client Sample ID.	Matrix	TOC mg C/L	Dilution Factor
X21368	MW-1110	Water	236	10
X21368 Dup	MW-1110 Dup	Water	232	10
Method Blank	(4/1/96)		<1.0	

Quality Assurance

		Spike Amount (mgC/L)	Sample Result (mgC/L)	Spike Result (mgC/L)	% Recovery
96-0979 X21457	Matrix Spike	10.0	2.5	12.8	103
X21457	Matrix Spike Dup	10.0	2.5	12.9	104
MS/MSD RPD					0.78

Analyst

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HUFFMAN

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NON-CLP ANALYSIS RESULTS

Date:	04/09/96		
Lab Name:	Huffman Labs	Client:	Evergreen Analytical
Contact:	Sue Zeller	Contact:	Patty McClellan
Sample Matrix:	solid	Huffman Lab #:	136896

	Client Smp#	Lab ID #	Element/ Compound	Dilution Factor	Results	Units	Prep Date	Analysis Date	Sample Size (g)	Method #	Instrument ID
	ESS4-(9'-10')	13689601	TC	NA	0.12	%	NA	04/03/96	0.421	Leco CR12	#7
	ESS4-(9'-10')	13689601	TC	NA	0.10	%	NA	04/03/96	0.898	Leco CR12	#7
	ESS18-9'-9.5'	13689602	TC	NA	0.11	%	NA	04/03/96	0.836	Leco CR12	#7
	ESS25-4-6.5	13689603	TC	NA	0.06	%	NA	04/03/96	0.946	Leco CR12	#7
	ESS26-8-10	13689604	TC	NA	1.18	%	NA	04/03/96	0.981	Leco CR12	#7
	ESS4-(9'-10')	13689601	CC	NA	<0.02	%	NA	04/05/96	0.125	COU-02	#2
	ESS4-(9'-10')	13689601	CC	NA	<0.02	%	NA	04/05/96	0.437	COU-02	#2
	ESS18-9'-9.5'	13689602	CC	NA	<0.02	%	NA	04/05/96	0.338	COU-02	#2
	ESS25-4-6.5	13689603	CC	NA	<0.02	%	NA	04/05/96	0.356	COU-02	#2
	ESS26-8-10	13689604	CC	NA	<0.02	%	NA	04/05/96	0.523	COU-02	#2
			% moisture			adjusted result					
X21374	ESS4-(9'-10')	13689601	TOC 23.37	NA	0.12	% 0.16	NA	NA	NA	by calc	NA
X21374 D	ESS4-(9'-10')	13689601	TOC 23.37	NA	0.10	% 0.13	NA	NA	NA	by calc	NA
X21375	ESS18-9'-9.5'	13689602	TOC 25.43	NA	0.11	% 0.15	NA	NA	NA	by calc	NA
	ESS25-4-6.5	13689603	TOC	NA	0.06	%	NA	NA	NA	by calc	NA
	ESS26-8-10	13689604	TOC	NA	1.18	%	NA	NA	NA	by calc	NA

Samples analyzed and results reported on as as received basis.
Soil samples are not homogeneous.

Values reported below Detection Limits are for reference only.

TC detection limit = 0.05%
CC detection limit = 0.02%
TOC detection limit = 0.05%

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LABORATORIES, INC.
Quality Analytical Services Since 1936
4630 Indiana Street • Golden, CO 80403

NON-CLP ANALYSIS RESULTS
LABORATORY CONTROL STANDARD

Date:	04/09/96	Client:	Evergreen Analytical
Lab Name:	Huffman Labs	Contact:	Patty McClellan
Contact:	Sue Zeller	Huffman Lab #:	136896

LABORATORY CONTROL STANDARD

Lab ID #	Source	Element/ Compound	True Value	Found Value	% R	Units	Date	Method #	Instrument ID
LCS	BN 4851	TC	3.35	3.32	99	%	04/03/96	Leco CR12	#7
LCS	BN 4056	CC	11.33	11.3	100	%	04/05/96	COU-02	#2

SPIKE RECOVERY

Lab ID #	Source	Element/ Compound	True Value	Found Value	% R	Units	Date	Method #	Instrument ID
SPIKE	BN 4712	TC	12120	11875	98	ug C	04/03/96	Leco CR12	#7
SPIKE DUP	BN 4712	TC	12240	12315	101	ug C	04/03/96	Leco CR12	#7
SPIKE	BN 4712	CC	817	902	110	ug C	04/05/96	COU-02	#2
SPIKE DUP	BN 4712	CC	830	917	110	ug C	04/05/96	COU-02	#2

HUFFMAN

LABORATORIES, INC.
Quality Analytical Services Since 1936
4630 Indiana Street • Golden, CO 80403

ЛON-CLP QA/QC ANALYSIS RESULTS
IAL AND CONTINUING CALIBRATION VERIFICATION

Date:	04/09/96	Client:	Evergreen Analytical
Lab Name:	Huffman Labs	Contact:	Patty McClellan
Contact:	Sue Zeller	Huffman Lab #:	136896

INITIAL CALIBRATION

Lab ID #	Source	Element/ Compound	True Value	Found Value	% R	Units	Date	Method #	Instrument ID
ICS	BN 4712	TC	12.00	11.87	99	%	04/03/96	Leco CR12	#7
ICS	BN 4712	CC	12.00	11.90	99	%	04/03/96	COU-02	#2

Slope = NA
Intercept = NA Single point calibrations for this test.
95% Correlation Coefficient = NA

CONTINUING CALIBRATION VERIFICATION

Lab ID #	Source	Element/ Compound	True Value	Found Value	% R	Units	Date	Method #	Instrument ID
CCS	BN 4712	TC	12.00	11.88	99	%	04/03/96	Leco CR12	#7
CCS	BN 4712	TC	12.00	11.90	99	%	04/03/96	Leco CR12	#7
CCS	BN 4712	CC	12.00	11.90	99	%	04/05/96	COU-02	#2

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ANALYSIS : **TOTAL CARBON**	METHOD : HIGH TEMP COMB. - INFRARED DET.
INSTRUMENT : LECO CR12	ANALYZER # 7
BALANCE # 19	

. CALCIUM CARBONATE FFMAN std # 133) 12.00 %C (theory) BN 2340	STD. N.I.S.T. BUFFALO RIVER SEDIMENT 2704 (HUFFMAN std # N2704) 3.348 %C (theory) BN 4851

SAMPLE #	SAMPLE WT G			% CARBON PRE-CALIB	% CARBON POST-CALIB		QC	% REC.
[redacted]								
133	0.0990			11.87	12.21		ICS	101.8
[redacted]								
133	0.1000				11.88		CCS	99.0
B1	1.0000				0.601		IB	
N2704	0.3190				3.323		LCS	99.3
MB	1.0000				0.001		MB	
[redacted]								

YST Miller	DATE 4-2-96	REVIEWED	DATE 4/3/96	PAGE 2 OF 3

rev 7/3/95

St: Sucrose Std bn 3743 Theory: 42.10

HUFFMAN
LABORATORIES, INC.
Quality Analytical Services Since 1936
4630 Indiana Street • Golden, CO 80403

ANALYSIS : **TOTAL CARBON**	METHOD : HIGH TEMP COMB. - INFRARED DET.
INSTRUMENT : LECO CR12	ANALYZER # 7
BALANCE # 19	

CALCIUM CARBONATE (HUFFMAN std # 133) 12.00 %C (theory) BN 2340	STD. N.I.S.T. BUFFALO RIVER SEDIMENT 2704 (HUFFMAN std # N2704) 3.348 %C (theory) BN 4851

SAMPLE #	SAMPLE WT G			% CARBON PRE-CALIB	% CARBON POST-CALIB		QC	% REC.
[redacted]								
133	0.1010				11.90		CCS	99.2
[illegible]01	0.4210		wt		0.116			
136801	0.898		wt		0.103		Dup	±5.97 of mean
136801	0.8470	}	wt (Entered)					
133	0.1010	}	Spike		1.512			
136801	0.8740	}	wt (Entered)					
133	0.1020	}	Spike		1.519			
136802	0.8360				0.107			
136803	0.9460				0.063			
136804	0.9510				1.184			
N2704	0.2600				3.455		CCS	103.2

ANALYST	DATE	REVIEWED	DATE	PAGE OF
[signature]	4-2-96	[signature]	4/3/96	3 of 3

rev 7/3/95

St: Sucrose Standard bn 3745 theory: 42.10

HUFFMAN
LABORATORIES, INC.
Quality Analytical Services Since 1936
4630 Indiana Street • Golden, CO 80403

ANALYSIS	CARBONATE CARBON	METHOD	SOP COU-02
ANALYZER #	6	COULOMETER #	2
BALANCE #	16		

CALCIUM CARBONATE STD # 133) $CaCO_3$	BOTTLE # 4712	% C THEORY = 12.00%	SODIUM CARBONATE (STD # 134) Na_2CO_3	BOTTLE # 2730 + 4713	%C THEORY = 11.33 %

SAMPLE NO.	TARE WT. GRAMS	TARE + SAMPLE WT.	SAMPLE WT. GRAMS	NOTES	(COUNTS) µ GRAMS CARBON	LESS BLANK 6.0	% CARBONATE CARBON AS CARBON	QC	% RECOVERY
blank					6.4			IB	
blank					7.8			MB	
blank					4.2			MB	
$CaCO_3$	1.435410	1.442210	.006800		815.0	809.0	11.90	LCS	99.1
[redacted]									
1368-01	1.301420	1.426260	.124840		7.7	1.7	.00136		
1368-01	1.416080	1.851040	.436960		6.8	.8	.000183		
ns +Spike 1368-01	1.403165	1.714565	.311400	⊛Spike 1.721370 .006805	907.8	901.8			
SD +Spike 1368-01	1.357100	1.721785	.364685	⊛Spike 1.728700 .006915	922.6	916.6			
1368-02	1.333940	1.~~33~~ 67 1970	.338030		8.4	2.4	<0.002		
1368-0?	1.397610	1.753910	.356300	bad gasoline smell	9.3	3.3	<0.002		
1368-03	1.341645	1.864275	.522630	no gasoline smell	9.2	3.2	.006		
#134 NaCO	1.451865	1.469795	.017930		2031.9	2025.9	11.30	LCS	99.7

ANALYST Kim Anderson	DATE 4-5-96	REVIEWED [illegible]	DATE 4/8/96	PAGE 1 OF

REVISED 7/13/95

6 min runs ⊛Spike $CaCO_3$

[redacted]

Evergreen Analytical Sample Log Sheet

Project # 96-0979

Date(s) Sampled: 03/27,28/96 COC

Date Due: 04/05/96-UST
04/12/96-OTHERS

[illegible]te Received: 03/29/96 0920

Holding Time(s): 03/29,30-NO_2,NO_3,
4/10,11-BTEX,TVH,ALKALINITY
Rush STANDARD

[illegible]nt Project I.D. 722450.15 EAKER AFB

Client: PARSONS ENGINEERING SCIENCE, INC.
Address: 1700 BROADWAY SUITE 900
DENVER, CO 80290
Contact: TODD HERRINGTON
Phone #831-8100 **Fax #**831-8208

Cooler Return N/A
E.A. Cooler # 394
Airbill # FEDEX 7221153752
Client P.O.

Special Invoicing/Billing

Special Instructions **+CHLOROBENZENE, TMB & TeMB's.**

Lab ID #	Client ID#	Analysis	Mtx	Btl	Loc
X21453A-D	ESMP-8S	BTEX+,TVH	W	40V	2
X21454A-D	ESMP-9S	BTEX+,TVH	W	40V	2
X21456A-D	MW-1138	BTEX+,TVH	W	40V	2
[illegible]57A-D	MW-1128	BTEX+,TVH	W	40V	2
X[illegible]9A-D	ESMP-4S	BTEX+,TVH	W	40V	2
X21465A-D	ESMP-2D	BTEX+,TVH	W	40V	2
X21466A-D	ESMP-5S	BTEX+,TVH	W	40V	2
X21467A-D	ESMP-3S	BTEX+,TVH	W	40V	2
X21455A	ESLF-22	BTEX+,TVH (%MOISTURE)	S	4WM	2
X21458A	ESLF-13(7-8.5)	BTEX+,TVH (%MOISTURE)	S	4WM	2
X21460A	ESSB-15(10-10.5)	BTEX+,TVH (%MOISTURE)	S	4WM	2
X21461A	ESSB-13(12-12.5)	BTEX+,TVH (%MOISTURE)	S	4WM	2
X21462A	ESS2-24-8-10	BTEX+,TVH (%MOISTURE)	S	4WM	2
X21464A	ESS26-8-10	BTEX+,TVH (%MOISTURE)	S	4WM	2
X21453F-H	ESMP-8S	METHANE	W	40V	2
X21454F-H	ESMP-9S	METHANE	W	40V	2
X21456F-H	MW-1138	METHANE	W	40V	2
X21457F-H	MW-1128	METHANE	W	40V	2
X21459F-H	ESMP-4S	METHANE	W	40V	2

R=Sample to be returned

T[illegible] GC/MS ___ GC X Metals ___ Wet Chem X HPLC ___ SxPrep ___

SxRec C QA/QC C Acctg C File Orig

Page 1 of 2 Page(s)

Custodian/Date: [illegible] 4/2/96
[illegible] 4/2/96

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 2

COMPANY Parsons ES
ADDRESS 1700 Broadway Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Todd Herrington
PROJECT I.D. 722450.15
EAL QUOTE # ________ P.O.# ________
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ________
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Shin Ozaki / Mark Vessley
(print) Shin Ozaki Mark Vessley
Evergreen Analytical Cooler No. 394
Cooler Received ________

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL Project # 96-0979
Custodian MJM

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Cl - NO3 NO2 SO4	Methane	Alkalinity	TOC	EAL Sample No.
ESMP-8S	3/28/96	7:50	8	X										X		X				X	X			X21453 A-H
ESMP-9S	3/28/96	8:30	8	X										X		X				X	X			54 A-H
ESLF-22	3/28/96	9:50	1		X									X		X	per PM 4/1/96							55 A (4WM)
~~ESMP-3~~																								
MW-113S	3/27/96	17:00	8	X										X		X				X	X	~~X~~		56 A-H
MW-112S	3/27/96	17:00	16	X										X		X				X	X	X	X	57 A-J
ESLF-13(7-8.5)	3/28/96	10:30	1		X									X		X								58 A (4WM)
ESMP-4S	3/28/96	10:40	8	X										X		X				X	X			59 A-H
~~ESSB-10~~																								
ESSB-15(10-10.5)	3/28/96	11:30	1		X									X		X								60A
HT:																								Location 2, A2
DD:														40V		40V				125 P	40 V	125 P	250 A	Container Size

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Sandra Holler	3/28	FSDS V	3/28 11 am			[signature]	3/29/96 0920

CHAIN OF CUSTODY RECORD NALYTICAL SERVICES REQUEST

Evergr Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY SAA
ADDRESS
CITY ______ STATE ______ ZIP ______
PHONE# ______ FAX # ______
FAX RESULTS Y / N

CLIENT CONTACT (print) SAA
PROJECT I.D.
EAL. QUOTE # ______ P.O.#
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify)
*expedited turnaround subject to additional fee

Sampler Name:
(signature) M. Vesey
(print) Shin Ozaki M. Vesey
Evergreen Analytical Cooler No. 394
Cooler Received

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL Project # 96-0979
Custodian MPM

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil/Solid	MATRIX: Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle) + TMB	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Anions Cl, NO2, NO3, SO4	Methane	Alkalinity	TOC	EAL Sample No.
ESSB-13 (12-12.5)	3/28/96	11:45	1		X									X		X								X21461A 4wm
~~ESMP-5S~~	~~3/28/96~~		~~8~~	~~X~~																				
~~ESMP-3S~~	~~3/28/96~~	~~14:15~~	~~8~~	~~X~~										~~X~~		~~X~~				~~X~~	~~X~~			
ESS24-8-10	3/28/96	14:20	1		X									X		X								X21462A 4wm
ESS25-4-6.5	3/28/96	14:50	1		X																		X	63A 4wm
ESS26-8-10	3/28/96	15:00	2		X									X		X							X	64A/B 4wm
ESMP-2D	3/28/96	15:10	8	X										X		X				X	X			65A-H
ESMP-5S	3/28/96	15:30	8 7	X										X		X				X	X			66A-G
ESMP-3S	3/28/96	14:15	8	X										X		X				X	X			67A-H
HT:																								Location 2, A2
DD:														40V		40V				125 P	40 V			Container Size ←

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Shin Ozaki	3/28 ...	ESNSY	3/28 ...			M. Martin	3/29/96 0920

Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3/29/96 0926 Shipped Via: Fed X 7221153752
(Airbill # if applicable)

Client : Parsons ES

Client Project ID(s): 722450.15

EAL Project #(s): 96- 0979 EAL Cooler(s): Y N

Cooler#	394				
Ice packs	Y N	Y N	Y N	Y N	Y N
Temperature °C	9				

	Y	N	N/A
1. Custody seal(s) present:		X	
Seals on cooler intact			X
Seals on bottle intact			X
2. Chain of Custody present:	X		
3. Samples Radioactive: (Comment on COC if > 0.5mr/h)		X	
4. Containers broken or leaking: (Comment on COC if Y)		X	
5. Containers labeled:	X		
6. COC agrees w/ bottles received: (Comment on COC if N)	X		
7. COC agrees w/ labels: (Comment on COC if N) ESMP-45 labelled as ESMP-4; ESMP55 labelled as ESMP-5		X	
8. Headspace in vials-waters only: (Comment on COC if Y)		X	
9. VOA samples preserved:	X		
10. pH measured on metals, cyanide or phenolics*:			X
List discrepancies			

*Non-EAL provided containers only, water samples only.

	Y	N
11. Metal samples present:		X
Total ____ , Dissolved ____ , TCLP ____		
D or PD to be filtered:		
T,TR,D,PD to be Preserved:		
12. Short holding times:	X	
Specify parameters NO3/NO2		
13. Multi-phase sample(s) present:		X
14. COC signed w/ date/time:	X	

Comments:

(Additional comments on back)

Custodian Signature/Date: [signature] 3/29/96

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Evergr Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 2

COMPANY Parsons ES
ADDRESS 1700 Broadway Suite 900
CITY Denver STATE Co ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Todd Herrington
PROJECT I.D. 722450.15
EAL. QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) ~~Shin~~ Mark Vessely
(print) Shin Ozaki Mark Vessley
Evergreen Analytical Cooler No. 394
Cooler Received ______

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL
Project # ______
Custodian ______

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle) and TMB	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Cl - NO3 NO4 SO4	Methane	Alkalinity	TOC	EAL Sample No.
ESMP-85	3/28/96	7:50	8	X										X		X				X	X			
ESMP-95	3/28/96	8:30	8	X										X		X				X	X			
ESLF-22	3/28/96	9:50	1		X									X		X	per P.M. 4/1/96 mym							
~~ESMP-3~~																								
MW-1138	3/27/96	17:00	8	X										X		X				X	X	~~X~~		
MW-1128	3/27/96	17:00	16	X										X		X				X	X	X	X	
ESLF-13 (7-8.5)	3/28/96	10:30	1		X									X		X								
ESMP-45	3/28/96	10:40	8	X										X		X				X	X			
~~ESSB~~ 10.																								
ESSB-15 (10-10.5)	3/28/96	11:30	1		X									X		X								
HT:																								Location
DD:																								Container Size

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Shin Ozaki	3/28	FSIDS V	3/28			[signature]	3/29/96 0920

CHAIN OF CUSTODY RECORD ' ' NALYTICAL SERVICES REQUEST

Everg Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 2 of 2

COMPANY SAA
ADDRESS
CITY ____ STATE ____ ZIP ____
PHONE# ____ FAX # ____ FAX RESULTS Y / N

CLIENT CONTACT (print) ____
PROJECT I.D. SAA
EAL. QUOTE # ____ P.O.# ____
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ____
*expedited turnaround subject to additional fee

Sampler Name:
(signature) [signature] [signature]
(print) Shin Ozaki M. Vossy
Evergreen Analytical Cooler No. 394
Cooler Received ____

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL Project # ____
Custodian ____

MATRIX / ANALYSIS REQUESTED

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	Water-Drinking/Discharge/Ground (circle)	Soil/Solid	Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle) + TMB	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Anions Cl, NO2, NO3, SO4	Methane	Alkalinity	TOC				EAL Sample No.
ESSB-13(12-12.5)	3/28/96	11:45	1		X									X		X											
~~ESMP-5S~~	~~3/28/96~~		~~8~~	~~X~~																							
~~ESMP-3S~~	~~3/28/96~~	~~14:15~~	~~8~~	~~X~~										~~X~~		~~X~~				~~X~~	~~X~~						
ESS24-8-10	3/28/96	14:20	1		X									X		X											
ESS25-4-6.5	3/28/96	14:50	1		X																		X				
ESS26-8-10	3/28/96	15:00	2		X									X		X							X				
ESMP-2D	3/28/96	15:10	8	X										X		X				X	X						
ESMP-5S	3/28/96	15:30	7	X										X		X				X	X						
ESMP-3S	3/28/96	14:15	8	X										X		X				X	X						

HT: | Location
DD: | Container Size

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Sonia Helda	3/28 11:00	FEDEX	3/28 11:00			[signature]	3/29/96 0920

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MEB1040196B	Client Project Number	: 722450.15
Date Prepared	: 4/1/96	Lab Project Number	: 96-0979
Dilution Factor	: 125	Matrix	: MEOH
		Lab File Number	: TVB10331039

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	U	12.5	mg/kg
Benzene	71-43-2	4/1/96	U	50	ug/kg
Toluene	108-88-3	4/1/96	U	50	ug/kg
Chlorobenzene	108-90-7	4/1/96	U	50	ug/kg
Ethyl Benzene	100-41-4	4/1/96	U	50	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	50	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	50	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	50	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	50	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	63	ug/kg
ID Surrogate Recovery:		105%		50%-132%	(Limits)
Surrogate Recovery:		101%		72%-118%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

[illegible]
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TVBX0979.XLS; 4/5/96; 1

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB1040296	Client Project Number	:	722450.15
Date Prepared	: 4/2/96	Lab Project Number	:	96-0979
Dilution Factor	: 1.0	Matrix	:	WATER
		Lab File Number	:	TVB10331068

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/2/96	U	0.1	mg/L
Benzene	71-43-2	4/2/96	U	0.4	ug/L
Toluene	108-88-3	4/2/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/2/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/2/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/2/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	0.5	ug/L
FID Surrogate Recovery:		102%		70%-121%	(Lir
PID Surrogate Recovery:		94%		82%-115%	(Lir

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K. Hollman
Approved

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB040396	Client Project Number	: 722450.15
Date Prepared	: 4/2/96	Lab Project Number	: 96-0979
Dilution Factor	: 1.0	Matrix	: WATER
		Lab File Number	: TVBX0401067

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	U	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
ID Surrogate Recovery:		106%		70%-130%	(Limits)
Surrogate Recovery:		108%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

[signature]
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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	:	MB1040396	Client Project Number	:	722450.15
Date Prepared	:	4/3/96	Lab Project Number	:	96-0979
Dilution Factor	:	1.0	Matrix	:	WATER
			Lab File Number	:	TVB10402033

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	U	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
FID Surrogate Recovery:		106%		70%-121%	(Lir
PID Surrogate Recovery:		96%		82%-115%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blicha
Analyst

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP-8S	Client Project Number	: 722450.15
Lab Sample Number	: X21453	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: WATER
Date Received	: 3/29/96	Lab File Number(s)	: TVBX0401068
Date Prepared	: 4/2/96	Method Blank	: MB040396
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	U	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	1.2	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
Surrogate Recovery:		105%		70%-130%	(Limits)
Surrogate Recovery:		106%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

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TVBP0979.XLS; 4/4/96; 2

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP-9S	Client Project Number	: 722450.15
Lab Sample Number	: X21454	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: WATER
Date Received	: 3/29/96	Lab File Number(s)	: TVBX0401069
Date Prepared	: 4/2/96	Method Blank	: MB040396
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	U	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	1.8	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
FID Surrogate Recovery:		102%		70%-130%	(Li
PID Surrogate Recovery:		105%		70%-128%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MW-1138	Client Project Number	: 722450.15
Lab Sample Number	: X21456	Lab Project Number	: 96-0979
Date Sampled	: 3/27/96	Matrix	: WATER
Date Received	: 3/29/96	Lab File Number(s)	: TVBX0401070
Date Prepared	: 4/2/96	Method Blank	: MB040396
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	0.3	0.1	mg/L
Benzene	71-43-2	4/3/96	3.2	0.4	ug/L
Toluene	108-88-3	4/3/96	0.7	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	0.9	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	2.7	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	1.0	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
Surrogate Recovery:		105%		70%-130%	(Limits)
Surrogate Recovery:		107%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

TVBP0979.XLS; 4/4/96; 4

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	MW-1128	Client Project Number	:	722450.15
Lab Sample Number	:	X21457	Lab Project Number	:	96-0979
Date Sampled	:	3/27/96	Matrix	:	WATER
Date Received	:	3/29/96	Lab File Number(s)	:	TVBX0401076
Date Prepared	:	4/3/96	Method Blank	:	MB040396
FID Dilution Factor	:	1.0			
PID Dilution Factor	:	1.0			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	0.3	0.1	mg/L
Benzene	71-43-2	4/3/96	3.2	0.4	ug/L
Toluene	108-88-3	4/3/96	0.5	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	0.9	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	2.9	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	0.9	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	0.5	0.5	ug/L
FID Surrogate Recovery:		102%		70%-130%	(Li
PID Surrogate Recovery:		106%		70%-128%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Holliman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESLF-22	Client Project Number	: 722450.15
Lab Sample Number	: X21455	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/29/96	Lab File Number(s)	: TVB10331041
Date Prepared	: 4/1/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 500	Soil Extracted?	: YES
PID Dilution Factor	: 500	Soil Moisture	: 22.57%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	890	65	mg/kg
Benzene	71-43-2	4/1/96	12000	258	ug/kg
Toluene	108-88-3	4/1/96	46000	258	ug/kg
Chlorobenzene	108-90-7	4/1/96	U	258	ug/kg
Ethyl Benzene	100-41-4	4/1/96	11000	258	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/1/96	57000	258	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/1/96	9400	258	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/1/96	26000	258	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/1/96	6900	258	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	8500	323	ug/kg
Surrogate Recovery:		106%		65%-129%	(Limits)
Surrogate Recovery:		93%		65%-129%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
VH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESLF-13(7-8.5)	Client Project Number	: 722450.15
Lab Sample Number	: X21458	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/29/96	Lab File Number(s)	: TVB10402022
Date Prepared	: 4/1/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 1250	Soil Extracted?	: YES
PID Dilution Factor	: 1250	Soil Moisture	: 19.18%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	3600	155	mg/kg
Benzene	71-43-2	4/3/96	6500	619	ug/kg
Toluene	108-88-3	4/3/96	160000	619	ug/kg
Chlorobenzene	108-90-7	4/3/96	U	619	ug/kg
Ethyl Benzene	100-41-4	4/3/96	38000	619	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/3/96	170000	619	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/3/96	49000	619	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/3/96	150000	619	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/3/96	56000	619	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	31000	773	ug/kg
FID Surrogate Recovery:		106%		65%-129%	(L
PID Surrogate Recovery:		93%		65%-129%	(L

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

Approved

TVBX0979.XLS; 4/5/96; 3

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESSB-15(10-10.5)	Client Project Number	: 722450.15
Lab Sample Number	: X21460	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/29/96	Lab File Number(s)	: TVB10402013
Date Prepared	: 4/2/96	Method Blank	: MB1040296
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 25.97%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/2/96	0.3	0.1	mg/kg
Benzene	71-43-2	4/2/96	1.8	0.5	ug/kg
Toluene	108-88-3	4/2/96	3.2	0.5	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	0.5	ug/kg
Ethyl Benzene	100-41-4	4/2/96	U	0.5	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	3.4	0.5	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	0.5	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	2.3	0.5	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	0.5	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	0.7	ug/kg
Surrogate Recovery:		90%		50%-132%	(Limits)
Surrogate Recovery:		91%		72%-118%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESSB-13(12-12.5)	Client Project Number	: 722450.15
Lab Sample Number	: X21461	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/29/96	Lab File Number(s)	: TVB10331048
Date Prepared	: 4/1/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 500	Soil Extracted?	: YES
PID Dilution Factor	: 500	Soil Moisture	: 25.97%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	1000	68	mg/kg
Benzene	71-43-2	4/1/96	1200	270	ug/kg
Toluene	108-88-3	4/1/96	17000	270	ug/kg
Chlorobenzene	108-90-7	4/1/96	U	270	ug/kg
Ethyl Benzene	100-41-4	4/1/96	9600	270	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/1/96	39000	270	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/1/96	13000	270	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/1/96	42000	270	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/1/96	15000	270	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	8300	338	ug/k
FID Surrogate Recovery:		105%		65%-129%	(Li
PID Surrogate Recovery:		93%		65%-129%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hallman
Analyst

Amcclelle
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESS24-8-10	Client Project Number	: 722450.15
Lab Sample Number	: X21462	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/29/96	Lab File Number(s)	: TVB10402024
Date Prepared	: 4/1/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 125	Soil Extracted?	: YES
PID Dilution Factor	: 125	Soil Moisture	: 25.68%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	200	17	mg/kg
Benzene	71-43-2	4/3/96	990	67	ug/kg
Toluene	108-88-3	4/3/96	2800	67	ug/kg
Chlorobenzene	108-90-7	4/3/96	U	67	ug/kg
Ethyl Benzene	100-41-4	4/3/96	1700	67	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/3/96	7000	67	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/3/96	3100	67	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/3/96	9600	67	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/3/96	2300	67	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	1900	84	ug/kg
Surrogate Recovery:		107%		65%-129%	(Limits)
Surrogate Recovery:		92%		65%-129%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

TVBX0979.XLS: 4/5/96; 6

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESS26-8-10	Client Project Number	: 722450.15
Lab Sample Number	: X21464	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/29/96	Lab File Number(s)	: TVB10402025,63,67
Date Prepared	: 4/1/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 12500	Soil Extracted?	: YES
PID Dilution Factor	: 1250,12500,50000	Soil Moisture	: 8.07%

Compound Name		Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/4/96	47000	1360	mg/kg
Benzene	71-43-2	4/3/96	130000	544	ug/kg
Toluene	108-88-3	4/4/96	1800000	21700	ug/kg
Chlorobenzene	108-90-7	4/3/96	24000	544	ug/kg
Ethyl Benzene	100-41-4	4/4/96	600000	5440	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/4/96	2800000	21700	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/4/96	570000	5440	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/4/96	1500000	21700	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/4/96	410000	5400	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/4/96	390000	5400	ug/kg
FID Surrogate Recovery:		101%		65%-129%	(Li
PID Surrogate Recovery:		98,92,& 91%		65%-129%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP-4S	Client Project Number	: 722450.15
Lab Sample Number	: X21459	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: WATER
Date Received	: 3/29/96	Lab File Number(s)	: TVBX0403005
Date Prepared	: 4/3/96	Method Blank	: MB040396
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	U	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	0.7	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	0.7	0.5	ug/L
Surrogate Recovery:		97%		70%-130%	(Limits)
Surrogate Recovery:		101%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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EVERGREEN ANALYTICAL, INC.
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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP-2D	Client Project Number	: 722450.15
Lab Sample Number	: X21465	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: WATER
Date Received	: 3/29/96	Lab File Number(s)	: TVBX0403006
Date Prepared	: 4/3/96	Method Blank	: MB040396
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	2.0	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	2.9	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	0.6	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
FID Surrogate Recovery:		99%		70%-130%	(Lin
PID Surrogate Recovery:		104%		70%-128%	(Lin

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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EVERGREEN ANALYTICAL, INC.
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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP-5S	Client Project Number	: 722450.15
Lab Sample Number	: X21466	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: WATER
Date Received	: 3/29/96	Lab File Number(s)	: TVBX0403007
Date Prepared	: 4/3/96	Method Blank	: MB040396
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	0.2	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	0.7	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
Surrogate Recovery:		101%		70%-130%	(Limits)
Surrogate Recovery:		106%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA =Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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TVBP0979.XLS; 4/4/96; 8

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP-3S	Client Project Number	: 722450.15
Lab Sample Number	: X21467	Lab Project Number	: 96-0979
Date Sampled	: 3/28/96	Matrix	: WATER
Date Received	: 3/29/96	Lab File Number(s)	: TVBX0403008
Date Prepared	: 4/3/96	Method Blank	: MB040396
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	U	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	0.4	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
FID Surrogate Recovery:		101%		70%-130%	(Li
PID Surrogate Recovery:		107%		70%-128%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	: ESMP-8S	Client Project No.	: 722450.15
Lab Sample No.	: X21453	Lab Project No.	: 96-0979
Date Sampled	: 3/28/96	EPA Method No.	: 602/8020
Date Received	: 3/29/96	Matrix	: Water
Date Prepared	: 4/2/96	Lab File Number(s)	: TVBX0401071,72
Date Analyzed	: 4/3/96	Method Blank	: MB040396
		Dilution Factor	: 1.0

Compound	Spike Added (ug/L)	Sample Concentration (ug/L)	Concentration (ug/L) MS	Concentration (ug/L) MSD	Comments
Benzene	20.0	0.0	19.6	19.8	
Toluene	20.0	1.2	21.4	21.2	
Chlorobenzene	20.0	0.0	19.9	20.0	
Ethylbenzene	20.0	0.0	20.0	20.2	
m,p-Xylene	20.0	0.0	20.4	20.5	
o-Xylene	20.0	0.0	19.8	19.9	
1,3,5-TMB	20.0	0.0	19.3	19.5	
1,2,4-TMB	20.0	0.0	19.4	19.6	
1,2,3-TMB	20.0	0.0	20.0	20.1	
1,2,3,4-TeMB	20.0	0.0	19.8	20.9	
Surrogate	100.0	106%	106%	106%	% RECOVERY

Compound	MS % RECOVERY	MSD % RECOVERY	RPD	QC# Limits RPD	QC# Limits %REC
Benzene	98.0	99.0	1.0	25	50 - 150
Toluene	101.0	100.0	1.0	25	50 - 148
Chlorobenzene	99.5	100.0	0.5	25	55 - 135
Ethylbenzene	100.0	101.0	1.0	25	50 - 150
m,p-Xylene	102.0	102.5	0.5	25	50 - 150
o-Xylene	99.0	99.5	0.5	25	50 - 150
1,3,5-TMB	96.5	97.5	1.0	25	50 - 150
1,2,4-TMB	97.0	98.0	1.0	25	50 - 150
1,2,3-TMB	100.0	100.5	0.5	25	50 - 150
1,2,3,4-TeMB	99.0	104.5	5.4	25	50 - 150
Surrogate	106.0	106.0	NA	NA	70 - 128

= Values taken from EPA methods 602/8020.
* = Values outside of QC limits.

RPD: 0 out of (10) outside limits.
Spike Recovery: 0 out of (20) outside limits.

Comments:

K. Hollman
Analyst

Approved

MBP0979.XLS; 4/4/96

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
TVH Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	:	ESMP-9S	Client Project No.	:	722450.15
Lab Sample No.	:	X21454	Lab Project No.	:	96-0979
Date Sampled	:	3/28/96	EPA Method No.	:	5030/8015 Modified
Date Received	:	3/29/96	Matrix	:	WATER
Date Prepared	:	4/3/96	Lab File Number(s)	:	TVBX0403009,10
Date Analyzed	:	4/3/96	Method Blank	:	MB040396
			Dilution Factor	:	1.0

Compound	Spike Added (mg/L)	Sample Concentration (mg/L)	MS Concentration (mg/L)	MS %REC	QC*** Limits %REC
Gasoline	2.00	0.00	2.40	120.0%	57-126
Surrogate **	---	---	---	100%	70-128

Compound	Spike Added (mg/L)	MSD Concentration (mg/L)	MSD %REC	RPD	QC*** Limits	
					RPD	%REC
Gasoline	2.00	2.18	109.0%	9.6	28.2	57-126
Surrogate **	---	---	101%	NA	NA	70-128

RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

Notes:
NA = Not analyzed/not applicable.
* = Value outside of QC limits.
** = 1,2,4-Trichlorobenzene
*** =Limits established 3/8/96. KSH

Comments:

K Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
Laboratory Control Sample (LCS)

LCS Number	: LCS040196-GW	Matrix	: WATER
Date Prepared	: 4/1/96	Method Numbers	: EPA 5030/8015 Modified
Date Analyzed	: 4/2/96		
Lab File Number(s)	: TVBX0401014		

Compound Name	Theoretical Concentration (mg/L)	LCS Concentration (mg/L)	LCS % Recovery	QC Limit** % Recovery
Gasoline	2.00	2.35	117.5	78 - 137
Surrogate Recovery:		103%		70 - 130

QUALIFIERS
B = TVH as Gasoline found in blank also.
E = Extrapolated value. Value exceeds calibration range.
NA = Not Available/Not Applicable.
** = Limits established 3/11/96 for TVHBTEX2. KSH

K Hollman
Analyst

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Approved

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TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
Laboratory Control Sample (LCS)

LCS Number	: LCS1040296GAS	Matrix	: WATER
Date Prepared	: 4/2/96	Method Numbers	: EPA 5030/8015 Modified
Date Analyzed	: 4/2/96		
Lab File Number(s)	: TVB10402001		

Compound Name	Theoretical Concentration (mg/L)	LCS Concentration (mg/L)	LCS % Recovery	QC Limit % Recovery
Gasoline	1.00	1.24	124	70 - 130
Surrogate Recovery:		104%		70 - 121

QUALIFIERS
B = TVH as Gasoline found in blank also.
E = Extrapolated value. Value exceeds calibration range.
NA = Not Available/Not Applicable.
** = Limits established 12/20/95 for TVHBTEX2. KSH

M. Blecha
Analyst

K Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St.
Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Data Report
Laboratory Control Sample (LCS)

LCS Number	: LCS1032996	Dilution Factor	: 1.00
Date Extracted/Prepared	: 3/29/96	Method	: 602/8020
Date Analyzed	: 3/29/96	Matrix	: Water
Spike Amount (ug/L)	: 20.0	Lab File No.	: TVB10328014

Compound Name	Cas Number	LCS Concentration (ug/L)	LCS % Recovery	QC Limit** % Recovery
Benzene	71-43-2	16.2	81.0	73 - 113
Toluene	108-88-3	16.9	84.5	78 - 114
Chlorobenzene	108-90-7	15.9	79.5	50 - 150
Ethyl Benzene	100-41-4	16.1	80.5	80 - 118
m,p-Xylene	108-38-3 106-42-3	31.7	79.3	78 - 116
ylene	95-47-6	17.6	88.0	79 - 122
M	1634-04-4	14.1	70.5	50 - 150
1,3,5-Trimethylbenzene	108-67-8	16.5	82.5	50 - 150
1,2,4-Trimethylbenzene	95-63-6	17.2	86.0	50 - 150
1,2,3-Trimethylbenzene	526-73-8	21.5	107.5	50 - 150
1,2,3,4-Tetramethylbenzene	488-23-3	24.9	124.5	50 - 150
Surrogate Recovery:		98%		82 - 115

NOTES: m,p-xylene = 40.0 ppb spike.

QUALIFIERS:
E = Extrapolated value. Value exceeds that of the calibration range.
U = Compound analyzed for, but not detected.
B = Compound found in blank and sample. Compare blank and sample data.
NA =Not available/Not analyzed.
= Limits updated 2/9/96 for TVHBTEX1. KSH

M. Blecha
Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St.
Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Data Report
Laboratory Control Sample (LCS)

LCS Number	: LCS033196-BW	Dilution Factor	: 1.00
Date Extracted/Prepared	: 3/31/96	Method	: 602/8020
Date Analyzed	: 3/31/96	Matrix	: Water
Spike Amount (ug/L)	: 20.0	Lab File No.	: TVBX0330033

Compound Name	Cas Number	LCS Concentration (ug/L)	LCS % Recovery	QC Limit** % Recovery
Benzene	71-43-2	19.2	96.0	73 - 122
Toluene	108-88-3	19.1	95.5	77 - 125
Chlorobenzene	108-90-7	18.2	91.0	82 - 122
Ethyl Benzene	100-41-4	19.6	98.0	78 - 126
m,p-Xylene	108-38-3 106-42-3	38.9	97.3	78 - 127
o-Xylene	95-47-6	19.2	96.0	77 - 1[illegible]
MTBE	1634-04-4	NA	NA	50 - 150
1,3,5-Trimethylbenzene	108-67-8	19.4	97.0	66 - 135
1,2,4-Trimethylbenzene	95-63-6	19.6	98.0	72 - 121
1,2,3-Trimethylbenzene	526-73-8	22.3	111.5	71 - 121
1,2,3,4-Tetramethylbenzene	488-23-3	19.6	98.0	58 - 147
Surrogate Recovery:		104%		70 - 128

NOTES: m,p-xylene = 40.0 ppb spike.

QUALIFIERS:
E = Extrapolated value. Value exceeds that of the calibration range.
U = Compound analyzed for, but not detected.
B = Compound found in blank and sample. Compare blank and sample data.
NA = Not available/Not analyzed.
** = Limits established 3/11/96 for TVHBTEX2..KSH

K. Hollman
Analyst

[illegible]
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form
Method Blank Report

Method Blank Number	: GB040896		Client Project No.	: 722450.15
Date Extracted/Prepared	: 4/8/96		Lab Project No.	: 96-0979
Date Analyzed	: 4/8/96		Dilution Factor	: 1.00
			Method	: RSKSOP-175
			Matrix	: Water
			Lab File No.	: GAS0408002

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

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Methane Report Form

[redacted] Sample Number	: ESMP-8S	Client Project No.	: 722450.15
Lab Sample Number	: X21453	Lab Project No.	: 96-0979
Date Sampled	: 3/28/96	Dilution Factor	: 1.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408006

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

mperature	: 73.2 F	Saturation Concentration	Meth	2.40814E-05
[redacted]nt Injected	: 0.5 ml			
[redacted]olume of Sample	: 43 ml	Concentration in Head Space	Meth	7.57041E-05
[redacted] space created	: 4 ml			
Methane Area	: 0.56 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted] Analyst

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(303) 425-6021

Methane Report Form

[redacted] Sample Number	: ESMP-9S	Client Project No.	: 722450.15
Lab Sample Number	: X21454	Lab Project No.	: 96-0979
Date Sampled	: 3/28/96	Dilution Factor	: 1.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408007

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

nperature	:	72.8 F	Saturation	Meth	1.02776E-05
[redacted]nt Injected	:	0.5 ml	Concentration		
[redacted]olume of Sample	:	43 ml	Concentration	Meth	3.23337E-05
Head space created	:	4 ml	in Head Space		
Methane Area	:	0.239 ug			

Atomic weight(Methane)	:	16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

Analyst

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Methane Report Form

Sample Number	: MW-1138	Client Project No.	: 722450.15
Lab Sample Number	: X21456	Lab Project No.	: 96-0979
Date Sampled	: 3/27/96	Dilution Factor	: 10.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408008

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.14	0.02

nperature	: 73.3 F	Saturation Concentration	Meth	0.032590245
nt Injected	: 0.05 ml			
olume of Sample	: 43 ml	Concentration in Head Space	Meth	0.10243409
He space created	: 4 ml			
Methane Area	: 75.787 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

[redacted] Sample Number	: MW1128	Client Project No.	: 722450.15
Lab Sample Number	: X21457	Lab Project No.	: 96-0979
Date Sampled	: 3/27/96	Dilution Factor	: 1.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408009

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.121	0.002

nperature	: 73.9 F	Saturation	Meth	0.029275876
[redacted]nt Injected	: 0.5 ml	Concentration		
[redacted]olume of Sample	: 43 ml	Concentration	Meth	0.091913205
Head space created	: 4 ml	in Head Space		
Methane Area	: 680.796 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

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Methane Report Form

[redacted] Sample Number	: MW-1128	Client Project No.	: 722450.15
Lab Sample Number	: X21457Dup	Lab Project No.	: 96-0979
Date Sampled	: 3/27/96	Dilution Factor	: 1.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408010

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.131	0.002

nperature	:	74.4 F
[redacted]nt Injected	:	0.5 ml
[redacted]Volume of Sample	:	43 ml
Head space created	:	4 ml
Methane Area	:	737.618 ug

Saturation Concentration	Meth	0.03171936
Concentration in Head Space	Meth	0.099491375

Atomic weight(Methane)	:	16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

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Methane Report Form

t Sample Number	: ESMP-4S	Client Project No.	: 722450.15
Lab Sample Number	: X21459	Lab Project No.	: 96-0979
Date Sampled	: 3/28/96	Dilution Factor	: 1.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408011

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

mperature	: 75.5 F	Saturation Concentration	Meth	0.000144101
nt Injected	: 0.5 ml			
Volume of Sample	: 43 ml	Concentration in Head Space	Meth	0.00045106
Head space created	: 4 ml			
Methane Area	: 3.351 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

t Sample Number	: ESMP-2D	Client Project No.	: 722450.15
Lab Sample Number	: X21465	Lab Project No.	: 96-0979
Date Sampled	: 3/28/96	Dilution Factor	: 1.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408012

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.095	0.002

mperature	:	74.7 F	Saturation Concentration	Meth	0.023049814
unt Injected	:	0.5 ml			
Volume of Sample	:	43 ml	Concentration in Head Space	Meth	0.072257749
Head space created	:	4 ml			
Methane Area	:	536.012 ug			
Atomic weight(Methane)	:	16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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Methane Report Form

[redacted]Sample Number	: ESMP-5S	Client Project No.	: 722450.15
Lab Sample Number	: X21466	Lab Project No.	: 96-0979
Date Sampled	: 3/28/96	Dilution Factor	: 1.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408013

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

ıperature	: 76.2 F	Saturation Concentration	Meth	3.98202E-05
[redacted]nt Injected	: 0.5 ml			
T[redacted]olume of Sample	: 43 ml	Concentration in Head Space	Meth	0.000124481
Hea[redacted] space created	: 4 ml			
Methane Area	: 0.926 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

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Methane Report Form

Sample Number	: ESMP-3S	Client Project No.	: 722450.15
Lab Sample Number	: X21467	Lab Project No.	: 96-0979
Date Sampled	: 3/28/96	Dilution Factor	: 1.00
Date Received	: 3/29/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Lab File No.	: GAS0408014

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

mperature	: 75.1 F	Saturation Concentration	Meth	0
nt Injected	: 0.5 ml			
olume of Sample	: 43 ml	Concentration in Head Space	Meth	0
space created	: 4 ml			
Methane Area	: 0 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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RSK-175 Gas Method
Methane, Ethane, Ethene Gas Matrix Spike / Matrix Spike Duplicate Report

Client Sample No.	: ESMP-8S	Client Project No.	: 722450.15
Lab Sample No.	: X21453	Lab Project No.	: 96-0979
Date Sampled	: 3/28/96	EPA Method No.	: RSKSOP-175
Date Received	: 3/29/96	Matrix	: Water
Date Prepared	: 4/8/96	Method Blank	: GB040896
Date Analyzed	: 4/8/96	Lab File No's.	: GAS0408016,017
E.A. MS/MSD Spike Source No.	: 1723		

Compound	Spike Added (ug)	Sample Concentration (ug)	MS Concentration (ug)	MS %REC	QC Limits %REC
Methane Gas	500	0	291	58	40-89

Compound	Spike Added (ug)	MSD Concentration (ug)	MSD %REC	RPD	QC Limits RPD	QC Limits %REC
Methane Gas	500	290	58	0.3	0-24.4	40-89

RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available

Note: The Spike was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

Analyst

Approved

MS0979.XLS; 4/8/96

Evergreen Analytical, Inc.
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(303) 425-6021

RSK-175 Gas Method
Methane LCS Report Form

LCS No.	: LCS040896	EPA Method No.	: RSKSOP-175
Date Prepared	: 4/8/96	Matrix	: Water
Date Analyzed	: 4/8/96	Method Blank	: GB040896
E.A. LCS Source No.	: 1723	Lab File No.	: GAS0408005

Compound	Spike Added (ug)	Method Blank Concentration (ug)	LCS Concentration (ug)	LCS %REC	QC Limits %REC
Methane Gas	500	0	340	68	67-85

Spike Recovery: 0 out of (1) outside limits.

Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/27-28/96	Client Project ID.	: 722450.15020
Date Received	: 3/29/96	Lab Project Number	: 96-0979
Date Prepared	: 4/2/96	Method	: EPA 300.0
Date Analyzed	: 4/2/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Chloride mg/L	Dilution Factor
X21453	ESMP-8S	Water	5.8	1
X21454	ESMP-9S	Water	3.5	1
X21456	MW-1138	Water	12.8	1
X21457	MW-1128	Water	12.6	1
X21459	ESMP-4S	Water	4.5	1
X21465	ESMP-2D	Water	3.1	1
X21466	ESMP-5S	Water	7.4	1
X21467	ESMP-3S	Water	5.2	1
Method Blank	(4/2/96)		<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21535 (96-0995)	Matrix Spike	10.0	6.6	18.0	114
X21535 (96-0995)	Matrix Spike Dup	10.0	6.6	17.9	111
MS/MSD RPD					2.7

[signature] Analyst

[signature] Approved

EVERGREEN ANALYTICAL, Inc.
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(303) 425-6021

Anion Report

Date Sampled	: 3/27-28/96		Client Project ID.	:	722450.15020
Date Received	: 3/29/96		Lab Project Number	:	96-0979
Date Prepared	: 4/2/96		Method	:	EPA 300.0
Date Analyzed	: 4/2/96		Detection Limit	:	0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
X21453	ESMP-8S	Water	30.6	1
X21454	ESMP-9S	Water	15.3	1
X21456	MW-1138	Water	29.5	1
X21457	MW-1128	Water	29.8	1
X21459	ESMP-4S	Water	23.1	1
X21465	ESMP-2D	Water	44.8	5
X21466	ESMP-5S	Water	77.8	10
X21467	ESMP-3S	Water	14.2	1
Method Blank	(4/2/96)		<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21535 (96-0995)	Matrix Spike	10.0	0.33	10.3	100
X21535 (96-0995)	Matrix Spike Dup	10.0	0.33	10.1	97
MS/MSD RPD					2.5

Jeff Hal

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
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(303) 425-6021

Anion Report

Date Sampled	:	3/27-28/96	Client Project ID.	:	722450.15020
Date Received	:	3/29/96	Lab Project Number	:	96-0979
Date Prepared	:	4/2/96	Method	:	EPA 300.0
Date Analyzed	:	4/2/96	Detection Limit	:	0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N[1] mg/L	Dilution Factor
X21453	ESMP-8S	Water	0.28	1
X21454	ESMP-9S	Water	0.12	1
X21456	MW-1138	Water	<0.056	1
X21457	MW-1128	Water	<0.056	1
X21459	ESMP-4S	Water	<0.056	1
X21465	ESMP-2D	Water	0.064	1
X21466	ESMP-5S	Water	0.059	1
X21467	ESMP-3S	Water	<0.056	1
Method Blank	(4/2/96)		<0.056	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21535 (96-0995)	Matrix Spike	10.0	<0.25	9.8	98
X21535 (96-0995)	Matrix Spike Dup	10.0	<0.25	9.9	99
MS/MSD RPD					1.3

* = Quality assurance results reported as Nitrate (NO_3).

[1] = Samples re-analyzed outside of holding time due to instrument problems. In the initial and re-analysis, no nitrite was detected. This would indicate that no conversion between NO_2 and NO_3 occured prior to re-analysis.

Analyst

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EVERGREEN ANALYTICAL, Inc.
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(303) 425-6021

Anion Report

Date Sampled	:	3/27-28/96	Client Project ID.	:	722450.15020
Date Received	:	3/29/96	Lab Project Number	:	96-0979
Date Prepared	:	4/2/96	Method	:	EPA 300.0
Date Analyzed	:	4/2/96	Detection Limit	:	0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N[1] mg/L	Dilution Factor
X21453	ESMP-8S	Water	<0.076	1
X21454	ESMP-9S	Water	<0.076	1
X21456	MW-1138	Water	<0.076	1
X21457	MW-1128	Water	<0.076	1
X21459	ESMP-4S	Water	<0.076	1
X21465	ESMP-2D	Water	<0.076	1
X21466	ESMP-5S	Water	<0.076	1
X21467	ESMP-3S	Water	<0.076	1
Method Blank	(4/2/96)		<0.076	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21535 (96-0995)	Matrix Spike	10.0	<0.25	10.0	100
X21535 (96-0995)	Matrix Spike Dup	10.0	<0.25	9.6	96
MS/MSD RPD					3.7

* = Quality assurance results reported as Nitrite (NO_2).

[1] = Samples re-analyzed outside of holding time due to instrument problems. In the initial and re-analysis, no nitrite was detected.

Analyst

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Analysis Report

Date Sampled	: 3/27/96	Client Project ID.	: 722450.15020
Date Received	: 3/29/96	Lab Project Number	: 96-0979
Date Prepared	: 4/1/96	Method	: EPA 310.1
Date Analyzed	: 4/1/96	Detection Limit	: 5.0 mg $CaCO_3$/L

Evergreen Sample #	Client Sample ID.	Matrix	Total Alkalinity (mg $CaCO_3$/L)	Dilution Factor
X21457	MW-1128	Water	187	1
Method Blank	(4/1/96)		<5.0	

Quality Assurance

Reference	True Value (mg$CaCO_3$/L)	Result (mg$CaCO_3$/L)	% Recovery
ERA Alkalinity Lot # 0814-95-02	120	125	104

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(303) 425-6021

Total Organic Carbon

Date Sampled	: 3/27/96		Client Project ID.	: 722450.15020
Date Received	: 3/29/96		Lab Project Number	: 96-0979
Date Prepared	: 4/1/96		Method	: EPA 415.1
Date Analyzed	: 4/1/96		Detection Limit	: 1.0 mg C/L

Evergreen Sample #	Client Sample ID.	Matrix	TOC mg C/L	Dilution Factor
X21457	MW-1128	Water	2.5	1
X21457 Dup	MW-1128 Dup	Water	2.8	1
Method Blank	(4/1/96)		<1.0	

Quality Assurance

		Spike Amount (mgC/L)	Sample Result (mgC/L)	Spike Result (mgC/L)	% Recovery
X21457	MW-1128 Matrix Spike	10.0	2.5	12.8	103
X21457	MW-1128 Matrix Spike Dup	10.0	2.5	12.9	104
MS/MSD RPD					0.78

Analyst

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HUFFMAN

LABORATORIES, INC.

Quality Analytical Services Since 1936

4630 Indiana Street • Golden, CO 80403

NON-CLP ANALYSIS RESULTS

Date:	04/09/96		
Lab Name:	Huffman Labs	Client:	Evergreen Analytical
Contact:	Sue Zeller	Contact:	Patty McClellan
Sample Matrix:	solid	Huffman Lab #:	136896

Client Smp#	Lab ID #	Element/ Compound	Dilution Factor	Results	Units	Prep Date	Analysis Date	Sample Size (g)	Method #	Instrument ID
ESS4-(9'-10')	13689601	TC	NA	0.12	%	NA	04/03/96	0.421	Leco CR12	#7
ESS4-(9'-10')	13689601	TC	NA	0.10	%	NA	04/03/96	0.898	Leco CR12	#7
ESS18-9'-9.5'	13689602	TC	NA	0.11	%	NA	04/03/96	0.836	Leco CR12	#7
ESS25-4-6.5	13689603	TC	NA	0.06	%	NA	04/03/96	0.946	Leco CR12	#7
ESS26-8-10	13689604	TC	NA	1.18	%	NA	04/03/96	0.981	Leco CR12	#7
ESS4-(9'-10')	13689601	CC	NA	<0.02	%	NA	04/05/96	0.125	COU-02	#2
ESS4-(9'-10')	13689601	CC	NA	<0.02	%	NA	04/05/96	0.437	COU-02	#2
ESS18-9'-9.5'	13689602	CC	NA	<0.02	%	NA	04/05/96	0.338	COU-02	#2
ESS25-4-6.5	13689603	CC	NA	<0.02	%	NA	04/05/96	0.356	COU-02	#2
ESS26-8-10	13689604	CC	NA	<0.02	%	NA	04/05/96	0.523	COU-02	#2
		% moisture			adjusted result					
ESS4-(9'-10')	13689601	TOC	NA	0.12	%	NA	NA	NA	by calc	NA
ESS4-(9'-10')	13689601	TOC	NA	0.10	%	NA	NA	NA	by calc	NA
ESS18-9'-9.5'	13689602	TOC	NA	0.11	%	NA	NA	NA	by calc	NA
463 ESS25-4-6.5	13689603	TOC 11.71	NA	0.06	% 0.07	NA	NA	NA	by calc	NA
464 ESS26-8-10	13689604	TOC 8.07	NA	1.18	% 1.28	NA	NA	NA	by calc	NA

Samples analyzed and results reported on as as received basis.
Soil samples are not homogeneous.

Values reported below Detection Limits are for reference only.

TC detection limit = 0.05%
CC detection limit = 0.02%
TOC detection limit = 0.05%

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NON-CLP ANALYSIS RESULTS
LABORATORY CONTROL STANDARD

Date:	04/09/96	Client:	Evergreen Analytical
Lab Name:	Huffman Labs	Contact:	Patty McClellan
Contact:	Sue Zeller	Huffman Lab #:	136896

LABORATORY CONTROL STANDARD

Lab ID #	Source	Element/ Compound	True Value	Found Value	% R	Units	Date	Method #	Instrument ID
LCS	BN 4851	TC	3.35	3.32	99	%	04/03/96	Leco CR12	#7
LCS	BN 4056	CC	11.33	11.3	100	%	04/05/96	COU-02	#2

SPIKE RECOVERY

Lab ID #	Source	Element/ Compound	True Value	Found Value	% R	Units	Date	Method #	Instrument ID
SPIKE	BN 4712	TC	12120	11875	98	ug C	04/03/96	Leco CR12	#7
SPIKE DUP	BN 4712	TC	12240	12315	101	ug C	04/03/96	Leco CR12	#7
SPIKE	BN 4712	CC	817	902	110	ug C	04/05/96	COU-02	#2
SPIKE DUP	BN 4712	CC	830	917	110	ug C	04/05/96	COU-02	#2

HUFFMAN

LABORATORIES, INC.

Quality Analytical Services Since 1936

4630 Indiana Street • Golden, CO 80403

NON-CLP QA/QC ANALYSIS RESULTS
TIAL AND CONTINUING CALIBRATION VERIFICATION

Date:	04/09/96	Client:	Evergreen Analytical
Lab Name:	Huffman Labs	Contact:	Patty McClellan
Contact:	Sue Zeller	Huffman Lab #:	136896

INITIAL CALIBRATION

Lab ID #	Source	Element/ Compound	True Value	Found Value	% R	Units	Date	Method #	Instrument ID
ICS	BN 4712	TC	12.00	11.87	99	%	04/03/96	Leco CR12	#7
ICS	BN 4712	CC	12.00	11.90	99	%	04/03/96	COU-02	#2

Slope = NA

Intercept = NA Single point calibrations for this test.

95% Correlation Coefficient = NA

CONTINUING CALIBRATION VERIFICATION

Lab ID #	Source	Element/ Compound	True Value	Found Value	% R	Units	Date	Method #	Instrument ID
CCS	BN 4712	TC	12.00	11.88	99	%	04/03/96	Leco CR12	#7
CCS	BN 4712	TC	12.00	11.90	99	%	04/03/96	Leco CR12	#7
CCS	BN 4712	CC	12.00	11.90	99	%	04/05/96	COU-02	#2

Evergreen Analytical Sample Log Sheet

Project # 96-0995

Date(s) Sampled: 03/28,29/96 COC

Date Due: 04/08/96-UST
04/15/96-OTHERS

e Received: 03/30/96 0900

Holding Time(s): 3/30,31-NO_2,NO_3,
4/11,12-BTEX,TVH,METHANE,ALK.

C t Project I.D. EAKER 722450.15020

Rush STANDARD

Client: PARSONS ENGINEERING SCIENCE, INC.

Address: 1700 BROADWAY SUITE 900
DENVER, CO 80290

Contact: TODD HERRINGTON

Phone #831-8100 **Fax #**831-8208

Cooler Return 5.00

E.A. Cooler # N/A

Airbill # FEDEX 7221153730

Client P.O.

Special Invoicing/Billing

Special Instructions **+CHLOROBENZENE, TMB's & TeMB.**

Lab ID #	Client ID#	Analysis	Mtx	Btl	Loc
X21535A-D	TW-1105	BTEX+,TVH	W	40V	2
X21540A-D	ESMP23-D	BTEX+,TVH	W	40V	2
X21541A-D	ESMP6-S	BTEX+,TVH	W	40V	2
X²¹542A-D	ESMP-19	BTEX+,TVH	W	40V	2
543A-D	ESMP-22	BTEX+,TVH	W	40V	2
X2 0A	TRIP BLANK	BTEX+,TVH	W	40V	2
X21536A	ESSB28-8-10	BTEX+,TVH (% MOISTURE)	S	4WM	2
X21537A	ESSB27-8.5-10	BTEX+,TVH (% MOISTURE)	S	4WM	2
X21538A	ESSB29-7-8.5	BTEX+,TVH (% MOISTURE)	S	4WM	2
X21539A	ESSB29-8.5-10.25	BTEX+,TVH (% MOISTURE)	S	4WM	2
X21545A/B	ES-SW-1	BTEX+	W	40V	2
X21547A/B	ES-SW-2	BTEX+	W	40V	2
X21549A/B	ES-SW-3	BTEX+	W	40V	2
X21544A	ES-SED-1	BTEX+ (% MOISTURE)	S	4WM	2
X21546A	ES-SED-2	BTEX+ (% MOISTURE)	S	4WM	2
X21548A	ES-SED-3	BTEX+ (% MOISTURE)	S	4WM	2
X21534A/B	TW-1108	BTEX+,DENSITY	OIL	40V	10
X21535F-H	TW-1105	METHANE	W	40V	2
X21540F-H	ESMP23-D	METHANE	W	40V	2
X21541F-H	ESMP6-S	METHANE	W	40V	2

R=Sample to be returned

Ro GC/MS ___ GC X Metals ___ Wet Chem X HPLC ___ SxPrep
T
SxRec C QA/QC C Acctg C File Orig

Page 1 of 2 Page(s)

Custodian/Date: 4/2/96

Lab ID #	Client ID#	Analysis	Mtx	Btl	Loc
X21542F-H	ESMP-19	METHANE	W	40V	2
X21543F-H	ESMP-22	METHANE	W	40V	2
X21535E	TW-1105	Cl^-, NO_2, NO_3, SO_4	W	125P	A3
X21540E	ESMP23-D	Cl^-, NO_2, NO_3, SO_4	W	125P	A3
X21541E	ESMP6-S	Cl^-, NO_2, NO_3, SO_4	W	125P	A3
X21542E	ESMP-19	Cl^-, NO_2, NO_3, SO_4	W	125P	A3
X21543E	ESMP-22	Cl^-, NO_2, NO_3, SO_4	W	125P	A3
X21535I	TW-1105	ALKALINITY	W	125P	A3

Project # 96-0995

R=Sample to be returned

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Everg Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 1

COMPANY Parsons ES
ADDRESS 1700 Broadway
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Todd Herrington
PROJECT I.D. Eaker, 722450.15020
EAL. QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day)
☐ Other (Specify)______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) [signature]
(print) Shin Ozaki

Evergreen Analytical Cooler No. NA

Cooler Received

Please return cooler to Parsons

Please **PRINT** all information:

EAL use only
Do not write in shaded area

EAL Project # 96-0995
Custodian 9 & 2

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: Oily Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle) + TMB	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Density	Cl, NO2, NO3, SO4	Methane	Alkalinity	EAL Sample No.
TW-1108	3/28/96	16:30	2			X								X						X				X 21534 A/B
TW-1105	3/29/96	17:00	9	X										X		X					X	X	X	35 A-I
ESSB28-8-10	3/28/96	16:00	1			X								X		X								36 A
ESSB27-6.5-10	3/28/96	15:30	1			X								X		X								37 A
ESSB29-7-8.5	3/28/96	16:30	1			X								X		X								38 A
ESSB29-8.5-10.5	3/28/96	16:30	1			X								X		X								39 A
ESMP23-P	3/29/96	9:30	8	X										X		X					X	X		40 A-H
~~ESMP 2-S~~	~~3/?/96~~		~~8~~	~~X~~										~~X~~		~~X~~					~~X~~	~~X~~		—
ESMP6-S	3/29/96	11:30	7	X										X		X					X	X		41 A-G
ESMP-19	3/29/96	13:45	8	X										X		X					X	X		42 A-H
HT:																					125P	40V		Location 2, A3
DD:																								Container Size 40V/4WM

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	3/29 16:00	FEDEX	3/29 16:00	FED EX		[signature]	3-30-96

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY SAA
ADDRESS
CITY STATE ZIP
PHONE# FAX #
FAX RESULTS Y / N

CLIENT CONTACT (print) SAA
PROJECT I.D.
EAL. QUOTE # P.O.#
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day)
☐ Other (Specify)
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Sibley
(print) John C. S. Holford M. Vossley
Evergreen Analytical Cooler No. N/A
Cooler Received
Please return cooler to Parsons

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL Project # 96-0995
Custodian SL

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: Oil / Sludge	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle) + TMB	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Anions (Cl, NO2, NO3, SO4)	Methane	EAL Sample No.
ESMP-22	3/29/96	14:15	8	X										X		X				X	X	X21543A-H
ES-SED-1	3/29/96	2:45	1		X									X								44 A
ES-SW-1	3/29/96	2:45	2	X										X								45 A/B
ES-SED-2	3/29/96	2:50	1		X									X								46 A
ES-SW-2	3/29/96	2:50	2	X										X								47 A/B
ES-SED-3	3/29/96	2:55	1		X									X								48 A
ES-SW-3	3/29/96	2:55	2	X										X								49 A/B
Trip Blank	—	—	1	X										X		X						50 A
HT:																				25l	40V	Location 2, A3
DD:																						Container Size 40V/4WM

Instructions:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[illegible]	3/29/96	FedEx	3/29/96	FEDEX		[illegible]	3-30-96 0900

Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3-30-96 0900 Shipped Via: FEDEX 722115370
(Airbill # if applicable)

Client : PARSONS ES

Client Project ID(s): EAKER 722450.15620

EAL Project #(s): 96- 0995 EAL Cooler(s): Y N

Cooler#	CLIENT				
Ice packs	Y N	Y N	Y N	Y N	Y N
Temperature °C	7				

	Y	N	N/A
1. Custody seal(s) present:		✓	
Seals on cooler intact			✓
Seals on bottle intact			✓
2. Chain of Custody present:	✓		
3. Samples Radioactive: (Comment on COC if >0.5mr/h)		✓	
4. Containers broken or leaking: (Comment on COC if Y)		✓	
5. Containers labeled:	✓		
6. COC agrees w/ bottles received: (Comment on COC if N)	✓		
7. COC agrees w/ labels: (Comment on COC if N)	✓		
8. Headspace in vials-waters only: (Comment on COC if Y)		✓	
9. VOA samples preserved:	✓		
10. pH measured on metals, cyanide or phenolics*:			✓

List discrepancies ______

*Non-EAL provided containers only, water samples only.

	Y	N
11. Metal samples present:		✓
Total ____ , Dissolved ____ , TCLP ____		
D or PD to be filtered:		
T,TR,D,PD to be Preserved:		
12. Short holding times:	✓	
Specify parameters ANIONS		
13. Multi-phase sample(s) present:		✓
14. COC signed w/ date/time:	✓	

Comments: ______

(Additional comments on back)

Custodian Signature/Date: [signature] 3-30-96

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	:	MEB1040196B	Client Project Number	:	722450.15020
Date Prepared	:	4/1/96	Lab Project Number	:	96-0995
Dilution Factor	:	50.0	Matrix	:	MEOH
			Lab File Number	:	TVBX0401023

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	mg/kg
Benzene	71-43-2	4/2/96	U	20	ug/kg
Toluene	108-88-3	4/2/96	U	20	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	20	ug/kg
Ethyl Benzene	100-41-4	4/2/96	U	20	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	U	20	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	20	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	20	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	20	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	25	ug/kg
FID Surrogate Recovery:	NA			50%-132%	(Li
PID Surrogate Recovery:		103%		72%-118%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MEB1040196B	Client Project Number	: 722450.15020
Date Prepared	: 4/1/96	Lab Project Number	: 96-0995
Dilution Factor	: 125	Matrix	: MEOH
		Lab File Number	: TVB10331039

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	U	12.5	mg/kg
Benzene	71-43-2	4/1/96	U	50	ug/kg
Toluene	108-88-3	4/1/96	U	50	ug/kg
Chlorobenzene	108-90-7	4/1/96	U	50	ug/kg
Ethyl Benzene	100-41-4	4/1/96	U	50	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	50	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	50	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	50	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	50	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	63	ug/kg
FID Surrogate Recovery:		105%		50%-132%	(Limits)
PID Surrogate Recovery:		101%		72%-118%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB040196	Client Project Number	: 722450.15020
Date Prepared	: 3/30/96	Lab Project Number	: 96-0995
Dilution Factor	: 1.0	Matrix	: WATER
		Lab File Number	: TVBX0330061

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	U	0.1	mg/L
Benzene	71-43-2	4/1/96	U	0.4	ug/L
Toluene	108-88-3	4/1/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	0.5	ug/L
FID Surrogate Recovery:		98%		70%-130%	(Lir
PID Surrogate Recovery:		96%		70%-128%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB040296B	Client Project Number	:	722450.15020
Date Prepared	: 4/2/96	Lab Project Number	:	96-0995
Dilution Factor	: 1.0	Matrix	:	WATER
		Lab File Number	:	TVBX0401031

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/2/96	U	0.4	ug/L
Toluene	108-88-3	4/2/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/2/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/2/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/2/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	0.5	ug/L
) Surrogate Recovery:	NA			70%-130%	(Limits)
Surrogate Recovery:		101%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB1040296	Client Project Number	: 722450.15020
Date Prepared	: 4/2/96	Lab Project Number	: 96-0995
Dilution Factor	: 1.0	Matrix	: WATER
		Lab File Number	: TVB10331068

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/2/96	U	0.1	mg/L
Benzene	71-43-2	4/2/96	U	0.4	ug/L
Toluene	108-88-3	4/2/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/2/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/2/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/2/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	0.5	ug/L
FID Surrogate Recovery:		102%		70%-121%	(Lim[illegible]
PID Surrogate Recovery:		94%		82%-115%	(Lir

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecka
Analyst

K Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	:	MB1040396	Client Project Number	:	722450.15020
Date Prepared	:	4/3/96	Lab Project Number	:	96-0995
Dilution Factor	:	1.0	Matrix	:	WATER
			Lab File Number	:	TVB10402033

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	U	0.1	mg/L
Benzene	71-43-2	4/3/96	U	0.4	ug/L
Toluene	108-88-3	4/3/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/3/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/3/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/3/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/3/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/3/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/3/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	U	0.5	ug/L
'D Surrogate Recovery:		106%		70%-121%	(Limits)
ıD Surrogate Recovery:		96%		82%-115%	(Limits)

s: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: TW-1108	Client Project Number	: 722450.15020
Lab Sample Number	: X21534	Lab Project Number	: 96-0995
Date Sampled	: 3/28/96	Matrix	: OIL
Date Received	: 3/30/96	Lab File Number(s)	: TVBX0401037
Date Prepared	: 4/2/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 500,000		
PID Dilution Factor	: 500,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/2/96	9,900,000	200,000	ug/kg
Toluene	108-88-3	4/2/96	57,000,000	200,000	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	200,000	ug/kg
Ethyl Benzene	100-41-4	4/2/96	12,000,000	200,000	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	59,000,000	200,000	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	7,000,000	200,000	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	23,000,000	200,000	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	6,600,000	200,000	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	3,600,000	250,000	ug/kg
FID Surrogate Recovery:		NA		50%-132%	(Li
PID Surrogate Recovery:		102%		72%-118%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: TW-1105	Client Project Number	: 722450.15020
Lab Sample Number	: X21535	Lab Project Number	: 96-0995
Date Sampled	: 3/28/96	Matrix	: WATER
Date Received	: 3/30/96	Lab File Number(s)	: TVBX0401019,34
Date Prepared	: 4/1,2/96	Method Blank	: MB040196
FID Dilution Factor	: 100		MB040296B
PID Dilution Factor	: 100 & 1000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/2/96	200	10	mg/L
Benzene	71-43-2	4/2/96	23000	400	ug/L
Toluene	108-88-3	4/2/96	44000	400	ug/L
Chlorobenzene	108-90-7	4/2/96	U	40	ug/L
Ethyl Benzene	100-41-4	4/2/96	2900	40	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/2/96	15000	40	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/2/96	640	40	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/2/96	2300	40	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/2/96	740	40	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	260	50	ug/L
Surrogate Recovery:		99%		70%-130%	(Limits)
Surrogate Recovery:		101%, 97%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESSB28-8-10	Client Project Number	: 722450.15020
Lab Sample Number	: X21536	Lab Project Number	: 96-0995
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/30/96	Lab File Number(s)	: TVB10331052
Date Prepared	: 4/1/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 500	Soil Extracted?	: YES
PID Dilution Factor	: 500	Soil Moisture	: 24.79%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/2/96	1100	66	mg/kg
Benzene	71-43-2	4/2/96	6700	266	ug/kg
Toluene	108-88-3	4/2/96	40000	266	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	266	ug/kg
Ethyl Benzene	100-41-4	4/2/96	14000	266	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	70000	266	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	14000	266	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	41000	266	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	14000	266	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	9100	332	ug/kg
FID Surrogate Recovery:		102%		65%-129%	(Lin
PID Surrogate Recovery:		91%		65%-129%	(L

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA =Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESSB27-8.5-10	Client Project Number	: 722450.15020
Lab Sample Number	: X21537	Lab Project Number	: 96-0995
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/30/96	Lab File Number(s)	: TVB10331053
Date Prepared	: 4/1/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 500	Soil Extracted?	: YES
PID Dilution Factor	: 500	Soil Moisture	: 22.48%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/2/96	380	64	mg/kg
Benzene	71-43-2	4/2/96	2800	258	ug/kg
Toluene	108-88-3	4/2/96	14000	258	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	258	ug/kg
Ethyl Benzene	100-41-4	4/2/96	5000	258	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	26000	258	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	3600	258	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	15000	258	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	5800	258	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	2800	322	ug/kg
FID Surrogate Recovery:		103%		65%-129%	(Limits)
PID Surrogate Recovery:		92%		65%-129%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESSB29-7-8.5	Client Project Number	: 722450.15020
Lab Sample Number	: X21538	Lab Project Number	: 96-0995
Date Sampled	: 3/28/96	Matrix	: SOIL
Date Received	: 3/30/96	Lab File Number(s)	: TVB10402047
Date Prepared	: 4/3/96	Method Blank	: MEB1040196B
FID Dilution Factor	: 1250	Soil Extracted?	: YES
PID Dilution Factor	: 1250	Soil Moisture	: 12.71%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	3200	143	mg/kg
Benzene	71-43-2	4/3/96	U	573	ug/kg
Toluene	108-88-3	4/3/96	67000	573	ug/kg
Chlorobenzene	108-90-7	4/3/96	1200	573	ug/kg
Ethyl Benzene	100-41-4	4/3/96	35000	573	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/3/96	180000	573	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/3/96	53000	573	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/3/96	150000	573	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/3/96	58000	573	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	47000	716	ug/kg
FID Surrogate Recovery:		104%		65%-129%	(Li...
PID Surrogate Recovery:		92%		65%-129%	(...

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

nt Sample Number	:	ESSB29-8.5-10.25	Client Project Number	:	722450.15020
Lab Sample Number	:	X21539	Lab Project Number	:	96-0995
Date Sampled	:	3/28/96	Matrix	:	SOIL
Date Received	:	3/30/96	Lab File Number(s)	:	TVB10402048
Date Prepared	:	4/3/96	Method Blank	:	MEB1040196B
FID Dilution Factor	:	2500	Soil Extracted?	:	YES
PID Dilution Factor	:	2500	Soil Moisture	:	17.95%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/3/96	7600	305	mg/kg
Benzene	71-43-2	4/3/96	13000	1219	ug/kg
Toluene	108-88-3	4/3/96	250000	1219	ug/kg
Chlorobenzene	108-90-7	4/3/96	3400	1219	ug/kg
Ethyl Benzene	100-41-4	4/3/96	98000	1219	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/3/96	470000	1219	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/3/96	100000	1219	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/3/96	300000	1219	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/3/96	100000	1219	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/3/96	69000	1523	ug/kg
FID Surrogate Recovery:		104%		65%-129%	(Limits)
Surrogate Recovery:		93%		65%-129%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

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U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	ESMP23-D	Client Project Number	:	722450.15020
Lab Sample Number	:	X21540	Lab Project Number	:	96-0995
Date Sampled	:	3/29/96	Matrix	:	WATER
Date Received	:	3/30/96	Lab File Number(s)	:	TVBX0401020,35
Date Prepared	:	4/1,2/96	Method Blank	:	MB040196
FID Dilution Factor	:	50.0			MB040296B
PID Dilution Factor	:	50 & 100			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/2/96	32	5.0	mg/L
Benzene	71-43-2	4/2/96	11000	40	ug/L
Toluene	108-88-3	4/2/96	170	40	ug/L
Chlorobenzene	108-90-7	4/2/96	U	20	ug/L
Ethyl Benzene	100-41-4	4/2/96	860	20	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/2/96	120	20	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	20	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	20	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	20	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	42	25	ug/L
FID Surrogate Recovery:		101%		70%-130%	(Li
PID Surrogate Recovery:		102%, 100%		70%-128%	(L

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP6-S	Client Project Number	: 722450.15020
Lab Sample Number	: X21541	Lab Project Number	: 96-0995
Date Sampled	: 3/29/96	Matrix	: WATER
Date Received	: 3/30/96	Lab File Number(s)	: TVBX0401007
Date Prepared	: 4/1/96	Method Blank	: MB040196
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	U	0.1	mg/L
Benzene	71-43-2	4/1/96	1.8	0.4	ug/L
Toluene	108-88-3	4/1/96	2.2	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	0.5	ug/L
Surrogate Recovery:		100%		70%-130%	(Limits)
Surrogate Recovery:		102%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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TVBP0995.XLS; 4/4/96; 5

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	ESMP-19	Client Project Number	:	722450.15020
Lab Sample Number	:	X21542	Lab Project Number	:	96-0995
Date Sampled	:	3/29/96	Matrix	:	WATER
Date Received	:	3/30/96	Lab File Number(s)	:	TVBX0401008
Date Prepared	:	4/1/96	Method Blank	:	MB040196
FID Dilution Factor	:	1.0			
PID Dilution Factor	:	1.0			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	2.0	0.1	mg/L
Benzene	71-43-2	4/1/96	23	0.4	ug/L
Toluene	108-88-3	4/1/96	5.6	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	1.7	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	2.5	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	8.9	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	7.8	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	13	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	4.1	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	14	0.5	ug/L
FID Surrogate Recovery:		102%		70%-130%	(Li
PID Surrogate Recovery:		103%		70%-128%	(L

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	ESMP-22	Client Project Number	:	722450.15020
Lab Sample Number	:	X21543	Lab Project Number	:	96-0995
Date Sampled	:	3/29/96	Matrix	:	WATER
Date Received	:	3/30/96	Lab File Number(s)	:	TVBX0401021,36
Date Prepared	:	4/1,2/96	Method Blank	:	MB040196
FID Dilution Factor	:	50			MB040296B
PID Dilution Factor	:	50 & 200			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/2/96	83	5.0	mg/L
Benzene	71-43-2	4/2/96	11000	80	ug/L
Toluene	108-88-3	4/2/96	11000	80	ug/L
Chlorobenzene	108-90-7	4/2/96	U	20	ug/L
Ethyl Benzene	100-41-4	4/2/96	840	20	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/2/96	7800	20	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/2/96	510	20	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/2/96	1700	20	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/2/96	510	20	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	160	25	ug/L
Surrogate Recovery:		102%		70%-130%	(Limits)
urrogate Recovery:		104%,101%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ES-SED-1	Client Project Number	: 722450.15020
Lab Sample Number	: X21544	Lab Project Number	: 96-0995
Date Sampled	: 3/29/96	Matrix	: SOIL
Date Received	: 3/30/96	Lab File Number(s)	: TVB10402012
Date Prepared	: 4/2/96	Method Blank	: MB1040296
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 35.13%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/2/96	U	0.6	ug/kg
Toluene	108-88-3	4/2/96	19	0.6	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	0.6	ug/kg
Ethyl Benzene	100-41-4	4/2/96	U	0.6	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	U	0.6	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	0.6	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	0.6	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	0.6	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	0.8	ug/kg
FID Surrogate Recovery:	NA			50%-132%	(Lir
PID Surrogate Recovery:		57%	*	72%-118%	(L

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = The sample was re-analyzed confirming a low surrogate recovery.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ES-SW-1	Client Project Number	:	722450.15020
Lab Sample Number	: X21545	Lab Project Number	:	96-0995
Date Sampled	: 3/29/96	Matrix	:	WATER
Date Received	: 3/30/96	Lab File Number(s)	:	TVBX0401032
Date Prepared	: 4/2/96	Method Blank	:	MB040296B
FID Dilution Factor	: 1.0			
PID Dilution Factor	: 1.0			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/2/96	U	0.4	ug/L
Toluene	108-88-3	4/2/96	0.5	0.4	ug/L
Chlorobenzene	108-90-7	4/2/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/2/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/2/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	0.5	ug/L
Surrogate Recovery:	NA			70%-130%	(Limits)
Surrogate Recovery:		99%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

TVBP0995.XLS; 4/17/96; 8

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ES-SED-2	Client Project Number	: 722450.15020
Lab Sample Number	: X21546	Lab Project Number	: 96-0995
Date Sampled	: 3/29/96	Matrix	: SOIL
Date Received	: 3/30/96	Lab File Number(s)	: TVB10402006
Date Prepared	: 4/2/96	Method Blank	: MB1040296
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 43.90%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/2/96	U	0.7	ug/kg
Toluene	108-88-3	4/2/96	5.9	0.7	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	0.7	ug/kg
Ethyl Benzene	100-41-4	4/2/96	U	0.7	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	1.4	0.7	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	0.7	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	0.7	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	0.7	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	0.9	ug/kg
FID Surrogate Recovery:	NA			50%-132%	(Lim
PID Surrogate Recovery:		38%	*	72%-118%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = Surrogate recovery was low. The sample was re-analyzed with similar surrogate results.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ES-SW-2	Client Project Number	: 722450.15020
Lab Sample Number	: X21547	Lab Project Number	: 96-0995
Date Sampled	: 3/29/96	Matrix	: WATER
Date Received	: 3/30/96	Lab File Number(s)	: TVBX0401009
Date Prepared	: 4/1/96	Method Blank	: MB040196
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/1/96	U	0.4	ug/L
Toluene	108-88-3	4/1/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	0.5	ug/L
Surrogate Recovery:	NA			70%-130%	(Limits)
Surrogate Recovery:		102%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	ES-SED-3	Client Project Number	:	722450.15020
Lab Sample Number	:	X21548	Lab Project Number	:	96-0995
Date Sampled	:	3/29/96	Matrix	:	SOIL
Date Received	:	3/30/96	Lab File Number(s)	:	TVB100402004
Date Prepared	:	4/2/96	Method Blank	:	MB1040296
FID Dilution Factor	:	1.0	Soil Extracted?	:	NO
PID Dilution Factor	:	1.0	Soil Moisture	:	38.17%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/2/96	U	0.6	ug/kg
Toluene	108-88-3	4/2/96	U	0.6	ug/kg
Chlorobenzene	108-90-7	4/2/96	U	0.6	ug/kg
Ethyl Benzene	100-41-4	4/2/96	U	0.6	ug/kg
Total Xylenes (m,p,o)	1330-20-7	4/2/96	U	0.6	ug/kg
1,3,5-Trimethylbenzene	108-67-8	4/2/96	U	0.6	ug/kg
1,2,4-Trimethylbenzene	95-63-6	4/2/96	U	0.6	ug/kg
1,2,3-Trimethylbenzene	526-73-8	4/2/96	U	0.6	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	4/2/96	U	0.8	ug/kg
FID Surrogate Recovery:		NA		50%-132%	(Lir
PID Surrogate Recovery:		53%	*	72%-118%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = The sample was re-analyzed confirming a low surrogate recovery

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ES-SW-3	Client Project Number	: 722450.15020
Lab Sample Number	: X21549	Lab Project Number	: 96-0995
Date Sampled	: 3/29/96	Matrix	: WATER
Date Received	: 3/30/96	Lab File Number(s)	: TVBX0401010
Date Prepared	: 4/1/96	Method Blank	: MB040196
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	NA	NA	NA	NA
Benzene	71-43-2	4/1/96	U	0.4	ug/L
Toluene	108-88-3	4/1/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	0.5	ug/L
Surrogate Recovery:	NA			70%-130%	(Limits)
Surrogate Recovery:		102%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

TVBP0995.XLS; 4/17/96; 10

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: TRIP BLANK	Client Project Number	: 722450.15020
Lab Sample Number	: X21550	Lab Project Number	: 96-0995
Date Sampled	: NA	Matrix	: WATER
Date Received	: 3/30/96	Lab File Number(s)	: TVBX0401003
Date Prepared	: 4/1/96	Method Blank	: MB040196
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	U	0.1	mg/L
Benzene	71-43-2	4/1/96	U	0.4	ug/L
Toluene	108-88-3	4/1/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	0.5	ug/L
FID Surrogate Recovery:		102%		70%-130%	(Li
PID Surrogate Recovery:		103%		70%-128%	(Li

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

Approved

TVBP0995.XLS; 4/4/96; 11

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
TVH Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	: ESMP6-S	Client Project No.	: 722450.15020
Lab Sample No.	: X21541	Lab Project No.	: 96-0995
Date Sampled	: 3/29/96	EPA Method No.	: 5030/8015 Modified
Date Received	: 3/30/96	Matrix	: WATER
Date Prepared	: 4/1/96	Lab File Number(s)	: TVBX0401017,18
Date Analyzed	: 4/2/96	Method Blank	: MB040196
		Dilution Factor	: 1.0

Compound	Spike Added (mg/L)	Sample Concentration (mg/L)	MS Concentration (mg/L)	MS %REC	QC*** Limits %REC
Gasoline	2.00	0.00	2.18	109.0%	57-126
Surrogate **	---	---	---	101%	70-128

Compound	Spike Added (mg/L)	MSD Concentration (mg/L)	MSD %REC	RPD	QC*** Limits	
					RPD	%REC
Gasoline	2.00	1.94	97.0%	11.7	28.2	57-126
Surrogate **	---	---	99%	NA	NA	70-128

RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

Notes:
NA = Not analyzed/not applicable.
* = Value outside of QC limits.
** = 1,2,4-Trichlorobenzene
*** =Limits established 3/8/96. KSH

Comments:

K Hollman
Analyst

P. McClell
Approved

MSTP0995.XLS; 4/17/96; 1:20 PM

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	: ESMP-19	Client Project No.	: 722450.15020
Lab Sample No.	: X21542	Lab Project No.	: 96-0995
Date Sampled	: 3/29/96	EPA Method No.	: 602/8020
Date Received	: 3/30/96	Matrix	: Water
Date Prepared	: 4/1,2/96	Lab File Number(s)	: TVBX0401001,39
Date Analyzed	: 4/1,2/96	Method Blank	: MB040196,MB040296B
		Dilution Factor	: 1.0

Compound	Spike Added (ug/L)	Sample Concentration (ug/L)	Concentration (ug/L) MS	Concentration (ug/L) MSD	Comments
Benzene	20.0	23.1	39.0	36.2	
Toluene	20.0	5.6	21.3	20.1	
Chlorobenzene	20.0	1.7	18.8	15.9	
Ethylbenzene	20.0	2.5	19.8	17.1	
m,p-Xylene	20.0	5.6	23.0	19.7	
o-Xylene	20.0	3.3	20.3	16.7	
1,3,5-TMB	20.0	7.8	24.0	19.3	
1,2,4-TMB	20.0	13.1	29.2	23.1	
1,2,3-TMB	20.0	4.1	20.4	16.6	
1,2,3,4-TeMB	20.0	13.7	31.5	25.0	
Surrogate	100.0	103%	101%	102%	% RECOVERY

Compound		MS % RECOVERY	MSD % RECOVERY	RPD		QC# Limits RPD	QC# Limits %REC
Benzene		79.5	65.5	19.3		25	50 - 150
Toluene		78.5	72.5	7.9		25	50 - 148
Chlorobenzene		85.5	71.0	18.5		25	55 - 135
Ethylbenzene		86.5	73.0	16.9		25	50 - 150
m,p-Xylene		87.0	70.5	21.0		25	50 - 150
o-Xylene		85.0	67.0	23.7		25	50 - 150
1,3,5-TMB		81.0	57.5	33.9	*	25	50 - 150
1,2,4-TMB		80.5	50.0	46.7	*	25	50 - 150
1,2,3-TMB		81.5	62.5	26.4	*	25	50 - 150
1,2,3,4-TeMB		89.0	56.5	44.7	*	25	50 - 150
Surrogate		101.0	102.0	NA		NA	70 - 128

= Values taken from EPA methods 602/8020.
* = Values outside of QC limits.

RPD: 4 out of (10) outside limits.
Spike Recovery: 0 out of (20) outside limits.

Comments: The MSD was reanalyzed using a different VOA vial, resulting in better, but still low results. No other VOA vial is available to re-analyze or re-spike for this sample.
See X21631-MS/MSD.

K. Hellman
Analyst

Approved

MBP0995.XLS; 4/2/96

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St.
Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Data Report
Laboratory Control Sample (LCS)

LCS Number	: LCS1032996	Dilution Factor	: 1.00
Date Extracted/Prepared	: 3/29/96	Method	: 602/8020
Date Analyzed	: 3/29/96	Matrix	: Water
Spike Amount (ug/L)	: 20.0	Lab File No.	: TVB10328014

Compound Name	Cas Number	LCS Concentration (ug/L)	LCS % Recovery	QC Limit** % Recovery
Benzene	71-43-2	16.2	81.0	73 - 113
Toluene	108-88-3	16.9	84.5	78 - 114
Chlorobenzene	108-90-7	15.9	79.5	50 - 150
Ethyl Benzene	100-41-4	16.1	80.5	80 - 118
m,p-Xylene	108-38-3 106-42-3	31.7	79.3	78 - 116
ylene	95-47-6	17.6	88.0	79 - 122
M[redacted]	1634-04-4	14.1	70.5	50 - 150
1,3,5-Trimethylbenzene	108-67-8	16.5	82.5	50 - 150
1,2,4-Trimethylbenzene	95-63-6	17.2	86.0	50 - 150
1,2,3-Trimethylbenzene	526-73-8	21.5	107.5	50 - 150
1,2,3,4-Tetramethylbenzene	488-23-3	24.9	124.5	50 - 150
Surrogate Recovery:		98%		82 - 115

NOTES: m,p-xylene = 40.0 ppb spike.

QUALIFIERS:
E = Extrapolated value. Value exceeds that of the calibration range.
U = Compound analyzed for, but not detected.
B = Compound found in blank and sample. Compare blank and sample data.
NA =Not available/Not analyzed.
= Limits updated 2/9/96 for TVHBTEX1. KSH

Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

TOTAL VOLATILE HYDROCARBONS (TVH as Gasoline)
Laboratory Control Sample (LCS)

LCS Number	: LCS1040296GAS	Matrix	: WATER
Date Prepared	: 4/2/96	Method Numbers	: EPA 5030/8015 Modified
Date Analyzed	: 4/2/96		
Lab File Number(s)	: TVB10402001		

Compound Name	Theoretical Concentration (mg/L)	LCS Concentration (mg/L)	LCS % Recovery	QC Limit % Recovery
Gasoline	1.00	1.24	124	70 - 130
Surrogate Recovery:		104%		70 - 121

QUALIFIERS
B = TVH as Gasoline found in blank also.
E = Extrapolated value. Value exceeds calibration range.
NA = Not Available/Not Applicable.
** = Limits established 12/20/95 for TVHBTEX2. KSH

M. Blocha
Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form
Method Blank Report

Method Blank Number	:	GB040196	Client Project No.	:	722450.15020
Date Extracted/Prepared	:	4/1/96	Lab Project No.	:	96-0995
Date Analyzed	:	4/1/96	Dilution Factor	:	1.00
			Method	:	RSKSOP-175
			Matrix	:	Water
			Lab File No.	:	GAS0401002

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0995.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

t Sample Number	: TW-1105	Client Project No.	: 722450.15020
Lab Sample Number	: X21535	Lab Project No.	: 96-0995
Date Sampled	: 3/28/96	Dilution Factor	: 50.00
Date Received	: 3/30/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401016

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	3.8	0.1

mperature	: 73.8 F	Saturation	Meth	0.927454722
unt Injected	: 0.01 ml	Concentration		
Volume of Sample	: 43 ml	Concentration	Meth	2.912340585
space created	: 4 ml	in Head Space		
Methane Area	: 431.35 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0995.XLS

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(303) 425-6021

Methane Report Form

Sample Number	: ESMP23-D	Client Project No.	: 722450.15020
Lab Sample Number	: X21540	Lab Project No.	: 96-0995
Date Sampled	: 3/29/96	Dilution Factor	: 100.00
Date Received	: 3/30/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401017

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	3.0	0.2

mperature	: 75.7 F	Saturation Concentration	Meth	0.715156068
nt Injected	: 0.005 ml			
olume of Sample	: 43 ml	Concentration in Head Space	Meth	2.237718557
space created	: 4 ml			
Methane Area	: 166.306 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0995.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Sample Number	: ESMP6-S	Client Project No.	: 722450.15020
Lab Sample Number	: X21541	Lab Project No.	: 96-0995
Date Sampled	: 3/29/96	Dilution Factor	: 1.00
Date Received	: 3/30/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401018

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

mperature	: 76.8 F	Saturation Concentration	Meth	0
nt Injected	: 0.5 ml			
olume of Sample	: 43 ml	Concentration in Head Space	Meth	0
Head space created	: 4 ml			
Methane Area	: 0 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0995.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Sample Number	: ESMP6-S	Client Project No.	: 722450.15020
Lab Sample Number	: X21541Dup	Lab Project No.	: 96-0995
Date Sampled	: 3/29/96	Dilution Factor	: 1.00
Date Received	: 3/30/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401019

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	:	76.8 F
Amount Injected	:	0.5 ml
Total Volume of Sample	:	43 ml
Head space created	:	4 ml
Methane Area	:	0 ug
Atomic weight(Methane)	:	16 g

Saturation Concentration	Meth	0
Concentration in Head Space	Meth	0

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0995.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Sample Number	: ESMP-19	Client Project No.	: 722450.15020
La Sample Number	: X21542	Lab Project No.	: 96-0995
Date Sampled	: 3/29/96	Dilution Factor	: 1.00
Date Received	: 3/30/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401020

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.003	0.002

mperature	: 74.7 F	Saturation	Meth	0.00064981
ount Injected	: 0.5 ml	Concentration		
T olume of Sample	: 43 ml	Concentration	Meth	0.002037057
H space created	: 4 ml	in Head Space		
Methane Area	: 15.111 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0995.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Sample Number	: ESMP-22	Client Project No.	: 722450.15020
La ample Number	: X21543	Lab Project No.	: 96-0995
Date Sampled	: 3/29/96	Dilution Factor	: 50.00
Date Received	: 3/30/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401021

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	1.5	0.1

nperature	: 77.6 F	Saturation	Meth	0.354004533
nt Injected	: 0.01 ml	Concentration		
T olume of Sample	: 43 ml	Concentration	Meth	1.103758659
H space created	: 4 ml	in Head Space		
Methane Area	: 164.644 ug			

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0995.XLS

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

RSK-175 Gas Method
Methane LCS Report Form

LCS No.	: LCS040196	EPA Method No.	: RSKSOP-175
Date Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Method Blank	: GB040196
E.A. LCS Source No.	: 1723	Lab File No.	: GAS0401005

Compound	Spike Added (ug)	Method Blank Concentration (ug)	LCS Concentration (ug)	LCS %REC	QC Limits %REC
Methane Gas	500	0	399	80	67-85

Spike Recovery: 0 out of (1) outside limits.

Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

Approved

LCS0401.XLS; 4/2/96

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/28-29/96	Client Project ID.	: 722450.15020
Date Received	: 3/30/96	Lab Project Number	: 96-0995
Date Prepared	: 4/2/96	Method	: EPA 300.0
Date Analyzed	: 4/2/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N[1] mg/L	Dilution Factor
X21535	TW-1105	Water	<0.076	1
X21535 Dup	TW-1105 Duplicate	Water	<0.076	1
X21540	ESMP23-D	Water	<0.076	1
X21541	ESMP6-S	Water	<0.076	1
X21542	ESMP-19	Water	<0.076	1
X21543	ESMP-22	Water	<0.076	1
Method Blank	(4/2/96)		<0.076	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21535	TW-1105 Matrix Spike	10.0	<0.25	10.0	100
X21535	TW-1105 Matrix Spike Dup	10.0	<0.25	9.6	96
MS/MSD RPD					3.7

* = Quality assurance results reported as Nitrite (NO_2).

(1) = Samples re-analyzed outside of holding time due to instrument problems. In the initial and re-analysis, no nitrite was detected.

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/28-29/96		Client Project ID.	: 722450.15020
Date Received	: 3/30/96		Lab Project Number	: 96-0995
Date Prepared	: 4/2/96		Method	: EPA 300.0
Date Analyzed	: 4/2/96		Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
X21535	TW-1105	Water	0.32	1
X21535 Dup	TW-1105 Duplicate	Water	0.46	1
X21540	ESMP23-D	Water	1.8	1
X21541	ESMP6-S	Water	14.9	1
X21542	ESMP-19	Water	18.3	1
X21543	ESMP-22	Water	0.98	1
Method Blank	(4/2/96)		<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21535	TW-1105 Matrix Spike	10.0	0.33	10.3	100
X21535	TW-1105 Matrix Spike Dup	10.0	0.33	10.1	97
MS/MSD RPD					2.5

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Analysis Report

Date Sampled	: 3/28/96	Client Project ID.	: 722450.15020
Date Received	: 3/30/96	Lab Project Number	: 96-0995
Date Prepared	: 4/2/96	Matrix	: Product
Date Analyzed	: 4/296	Method	: ASTM D287

Evergreen Sample #	Client Sample ID.	Density @ 60 ° F
X21534	TW-1108	0.7687

Analyst

Approved

Evergreen Analytical Sample Log Sheet

Project # 96-0998

Date(s) Sampled: 03/29,30/96 COC

Date Due: 04/08/96-UST
04/15/96-OTHERS

e Received: 04/01/96 0920

Holding Time(s): 04/01-NO_2,NO_3
04/12,13-BTEX,TVH,METHANE

C[illegible]t Project I.D. EAKER AFB 722450.15020

Rush STANDARD

Client: PARSONS ENGINEERING SCIENCE, INC.
Address: 1700 BROADWAY SUITE 900
DENVER, CO 80290
Contact: TODD HERRINGTON
Phone #831-8100 **Fax #**831-8208

Cooler Return N/A
E.A. Cooler # N/A
Airbill # FEDEX 8188097234
Client P.O.

Special Invoicing/Billing

Special Instructions **+CHLOROBENZENE, TMB's & TeMB**

Lab ID #	Client ID#	Analysis	Mtx	Btl	Loc
X21631A-D	ESMP7S	BTEX+,TVH	W	40V	2
X21632A-D	ESMP2S	BTEX+,TVH	W	40V	2
X21633A-C	ESMP20	BTEX+,TVH	W	40V	2
[illegible]1E-G	ESMP7S	METHANE	W	40V	2
X2[illegible]1H	ESMP7S	Cl^-,NO_2,NO_3,SO_4	W	125P	A3

R=Sample to be returned

te GC/MS ___ GC X Metals ___ Wet Chem X HPLC ___ SxPrep ___

SxRec C QA/QC C Acctg C File Orig

Page 1 of 1 Page(s)

Custodian/Date: 4/2/96

Chain of Custody

Contact: Todd Herrington
Project: Eaker AFB, 722450.15020
Standard Turn Around.

Please Return Cooler to
Parsons ES

Groundwater Samples	Sample Date	Sample Time	# of Bottles	8020 BTEX+TMB	8015 TVPH	Methane	Anions Cl^-, NO_2, NO_3, SO_4
ESMP-7S	3/29 - 3/30/96	X21631A-H	8	X	X	X	X
ESMP-2S	3/30/96	X21632A-C ~~X2133~~	4	X	X		
ESMP-20	3/30/96	X21633A-C	3	X	X		

- 1 of 4 vials broken @ EAL, sample ESMP-2S
- ESMP-20 labelled as ESMP-20S on vials.
mjm 4/1/96

96-0998
mjm
Loc: 2, A3

Sampled By Mark Vessely + Sandra Hoffman

Sandra Hoffman Ⓑ 17:00 3/30/96, FEDEX 17:00 3/30/96

Rec'd @ EAL by [signature] 4/1/96 0920

Evergreen Analytical Sample Receipt/Check-In Record

Date & Time Rec'd: 4/1/96 0920 Shipped Via: FedX-8188097234
(Airbill # if applicable)

Client : Parsons ES

Client Project ID(s): Eaker AFB, 722450.15020

EAL Project #(s): 96-0998 EAL Cooler(s): Y N

Cooler# Client

Ice packs Y N Y N Y N Y N Y N

Temperature °C 10

	Y	N	N/A
1. Custody seal(s) present:		X	
Seals on cooler intact			X
Seals on bottle intact			X
2. Chain of Custody present:	X		
3. Samples Radioactive: (Comment on COC if >0.5mr/h)		X	
4. Containers broken or leaking: (Comment on COC if Y) 1 of 4 BTEX vials broken @ EAL, sample ESMP.25	X		
5. Containers labeled:	X		
6. COC agrees w/ bottles received: (Comment on COC if N)	X		
7. COC agrees w/ labels: (Comment on COC if N)	X		
8. Headspace in vials-waters only: (Comment on COC if Y)		X	
9. VOA samples preserved:	X		
10. pH measured on metals, cyanide or phenolics*:			X

List discrepancies

*Non-EAL provided containers only, water samples only.

	Y	N
11. Metal samples present:		X
Total ____ , Dissolved ____ , TCLP ____		
D or PD to be filtered:		
T,TR,D,PD to be Preserved:		
12. Short holding times:	X	
Specify parameters NO2/NO3		
13. Multi-phase sample(s) present:		X
14. COC signed w/ date/time:	X	

Comments:

(Additional comments on back)

Custodian Signature/Date: MJM 4/1/96

Chain of Custody

Contact: Todd Herrington
Project: Eaker AFB, 722450.15020
Standard Turn Around.

Please Return Coolers to
Parsons ES

				Analyses			
Groundwater Samples	Sample Date	Sample Time	# of Bottles	8020 BTEX+TMB	8015 TVPH	Methane	Anions Cl^-, NO_2, NO_3, SO_4
ESMP-75	3/29 - 3/30/96		8	X	X	X	X
ESMP-25	3/30/96		4	X	X		
ESMP-20	3/30/96		3	X	X		

- 1 of 4 vials broken @ EAL, sample ESMP-25 > mjm 4/1/96.
- ESMP-20 labelled as ESMP-20S on vials

Sampled By Mark Vessely + Saskia Hoffer

Saskia Hoffer 17:00 3/30/96, FEDEX 17:00 3/30/96

Rec'd @ EAL by [signature] 4/1/96 0920

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: MB040196	Client Project Number	: 722450.15020
Date Prepared	: 4/1/96	Lab Project Number	: 96-0998
Dilution Factor	: 1.0	Matrix	: WATER
		Lab File Number	: TVBX0330061

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	U	0.1	mg/L
Benzene	71-43-2	4/1/96	U	0.4	ug/L
Toluene	108-88-3	4/1/96	U	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	0.5	ug/L
FID Surrogate Recovery:		98%		70%-130%	(Limits)
PID Surrogate Recovery:		96%		70%-128%	(Limits)

es: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

[illegible]
Approved

TVBP0998.XLS; 4/2/96; 1

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: ESMP-2S	Client Project Number	: 722450.15020
Lab Sample Number	: X21632	Lab Project Number	: 96-0998
Date Sampled	: 3/30/96	Matrix	: WATER
Date Received	: 4/1/96	Lab File Number(s)	: TVBX0401005
Date Prepared	: 4/1/96	Method Blank	: MB040196
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	4/1/96	1.7	0.1	mg/L
Benzene	71-43-2	4/1/96	U	0.4	ug/L
Toluene	108-88-3	4/1/96	1.1	0.4	ug/L
Chlorobenzene	108-90-7	4/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	4/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	4/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	4/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	4/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	4/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	4/1/96	U	0.5	ug/L
FID Surrogate Recovery:		100%		70%-130%	(Limits)
PID Surrogate Recovery:		101%		70%-128%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

P McCall
Approved

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Matrix Spike/Matrix Spike Duplicate Data Report

Client Sample No.	: ESMP-7S	Client Project No.	: 722450.15020
Lab Sample No.	: X21631	Lab Project No.	: 96-0998
Date Sampled	: 3/29/96	EPA Method No.	: 602/8020
Date Received	: 4/1/96	Matrix	: Water
Date Prepared	: 4/2/96	Lab File Number(s)	: TVBX0401046,47
Date Analyzed	: 4/2/96	Method Blank	: MB040296B
		Dilution Factor	: 1.0

Compound	Spike Added (ug/L)	Sample Concentration (ug/L)	Concentration (ug/L) MS	Concentration (ug/L) MSD	Comments
Benzene	20.0	0.0	15.8	17.6	
Toluene	20.0	3.8	19.5	21.2	
Chlorobenzene	20.0	0.0	15.8	17.7	
Ethylbenzene	20.0	0.0	15.9	17.8	
m,p-Xylene	20.0	0.0	16.1	18.0	
o-Xylene	20.0	0.0	15.5	17.4	
1,3,5-TMB	20.0	0.0	15.5	17.5	
1,2,4-TMB	20.0	0.0	15.0	17.5	
1,2,3-TMB	20.0	0.0	15.6	17.9	
1,2,3,4-TeMB	20.0	0.0	16.1	18.3	
Surrogate	100.0	99%	106%	105%	% RECOVERY

Compound		MS % RECOVERY	MSD % RECOVERY	RPD	QC# Limits RPD	QC# Limits %REC
Benzene		79.0	88.0	10.8	25	50 - 150
Toluene		78.5	87.0	10.3	25	50 - 148
Chlorobenzene		79.0	88.5	11.3	25	55 - 135
Ethylbenzene		79.5	89.0	11.3	25	50 - 150
m,p-Xylene		80.5	90.0	11.1	25	50 - 150
o-Xylene		77.5	87.0	11.6	25	50 - 150
1,3,5-TMB		77.5	87.5	12.1	25	50 - 150
1,2,4-TMB		75.0	87.5	15.4	25	50 - 150
1,2,3-TMB		78.0	89.5	13.7	25	50 - 150
1,2,3,4-TeMB		80.5	91.5	12.8	25	50 - 150
Surrogate		106.0	105.0	NA	NA	70 - 128

= Values taken from EPA methods 602/8020.
* = Values outside of QC limits.

RPD: 0 out of (10) outside limits.
Spike Recovery: 0 out of (20) outside limits.

Comments:

K. Hollman
Analyst

McClelle
Approved

MBP0998.XLS; 4/3/96

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Sample Number	: ESMP-7S	Client Project No.	: 722450.15020
Lab Sample Number	: X21631	Lab Project No.	: 96-0998
Date Sampled	: 3/29,30/96	Dilution Factor	: 50.00
Date Received	: 4/1/96	Method	: RSKSOP-175
Date Extracted/Prepared	: 4/1/96	Matrix	: Water
Date Analyzed	: 4/1/96	Lab File No.	: GAS0401022

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.5	0.1

mperature	: 72.2 F	Saturation Concentration	Meth	0.113573695
unt Injected	: 0.01 ml			
T olume of Sample	: 43 ml	Concentration in Head Space	Meth	0.357711061
He space created	: 4 ml			
Methane Area	: 52.822 ug			
Atomic weight(Methane)	: 16 g			

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/30/96	Client Project ID.	: 722450.15020
Date Received	: 4/01/96	Lab Project Number	: 96-0998
Date Prepared	: 4/01/96	Method	: EPA 300.0
Date Analyzed	: 4/01/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Chloride mg/L	Dilution Factor
X21631	ESMP-7S	Water	4.6	1
21631 Dup	ESMP-7S Duplicate	Water	4.4	1
Method Blank	(4/01/96)		<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21631	ESMP-7S Matrix Spike	10.0	4.6	13.4	88
X21631	ESMP-7S Matrix Spike Dup	10.0	4.6	13.5	90
MS/MSD RPD					2.0

Jeff Hall
Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 3/30/96	Client Project ID.	: 722450.15020
Date Received	: 4/01/96	Lab Project Number	: 96-0998
Date Prepared	: 4/01/96	Method	: EPA 300.0
Date Analyzed	: 4/01/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
X21631	ESMP-7S	Water	<0.056	1
21631 Dup	ESMP-7S Duplicate	Water	<0.056	1
Method Blank	(4/01/96)		<0.056	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
X21631	ESMP-7S Matrix Spike	10.0	<0.25	9.6	96
X21631	ESMP-7S Matrix Spike Dup	10.0	<0.25	9.7	97
MS/MSD RPD					1.4

* = Quality assurance results reported as Nitrate (NO_3).

Analyst

Approved

APPENDIX D

BIOSCREEN MODEL INPUT PARAMETERS, MODEL OUTPUT, FIGURES OF MODEL OUTPUT, AND CALCULATIONS RELATED TO MODEL CALIBRATION

BIOSCREEN MODEL INPUT PARAMETERS
BX SHOPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Section	Parameter	Description	Model								
			BX1SCAL	BX1SMODA	BX1SMODB	BX1SMODC	BX2SCAL	BX2SMODA	BX2SMODB	BX2SMODC	BX1DCAL
Hydrogeology	*Vs*	Seepage Velocity (ft/year)	77.4	77.4	77.4	77.4	77.4	77.4	77.4	77.4	1.3
	K	Hydraulic Conductivity (cm/sec)	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.10E-03	1.20E-03
	i	Hydraulic Gradient (ft/ft)	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.00026
	n	Porosity	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dispersion	*alpha x*	Longitudinal Dispersivity (ft)	33	33	33	33	33	33	33	33	1.5
	alpha y	Transverse Dispersivity (ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	0.2
	alpha z	Vertical Dispersivity (ft)	0	0	0	0	0	0	0	0	0
Adsorption	R	Retardation Factor	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
	rho	Soil Bulk Density (kg/L)	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
	K_{oc}	Partition Coefficient (L/kg)	79	79	79	79	79	79	79	79	79
	f_{oc}	Fraction of Organic Carbon	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
Biodegradation											
1st-Order Model	*Lambda*	1st-Order Decay Coefficient (yr^{-1})	2.3	2.3	2.3	2.3	3.9	3.9	3.9	3.9	3.70E-02
	T-Half	Solute Half-Life (yr)	0.31	0.31	0.31	0.31	0.18	0.18	0.18	0.18	18.98
Instantaneous	DO	Delta Oxygen (mg/L)	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	2.1
Reaction Model	NO_3	Delta Nitrate (mg/L)	0	0	0	0	0	0	0	0	0
	FE^{2+}	Observed Ferrous Iron (mg/L)	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	19.6
	SO_4	Delta Sulfate (mg/L)	35.48	35.48	35.48	35.48	35.48	35.48	35.48	35.48	65.2
	CH_4	Observed Methane (mg/L)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3
General	NA	Modeled Area Length (ft)	300	500	500	500	300	500	500	500	200
	NA	Modeled Area Width (ft)	150	150	150	150	150	150	150	150	60
	NA	Simulation Time (yr)	10	20	20	20	10	20	20	20	20
Source Data	NA	Source Thickness in Sat. Zone (feet)	5	5	5	5	5	5	5	5	16
		Source Half-Life (yr)	Infinite	10	2-3	<1-1	Infinite	10	2-3	<1-1	Infinite
		Soluble Mass in LNAPL (kg)	Infinite	499	104	35	Infinite	499	104	35	Infinite

FIRST-ORDER RATE CONSTANT CALCULATION
USING TETRAMETHYLBENZENE AS A CONSERVATIVE TRACER
BX SHOPPETTE (SITE E1)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS

Point	Distance Downgradient (ft)	Travel Time Between Upgradient and Downgradient Point (days)	Measured Total BTEX Concentration (µg/L)	(1996) 1,2,3,4 Tetramethylbenzene Concentration (µg/L)	Trimethylbenzene-Corrected Total BTEX Concentration (µg/L)*
TW1105	0.00	0	84900 C_{i-1}	260 T_{i-1}	84900
CPT-22	24.44	157	30640 C_i	160.0 T_i	31208
TW1110	98.68	633	7660	63.0	8033

v_W = 0.21205 ft/day (Velocity of Groundwater)

v_c = 0.15592 ft/day (Velocity of Contaminant)

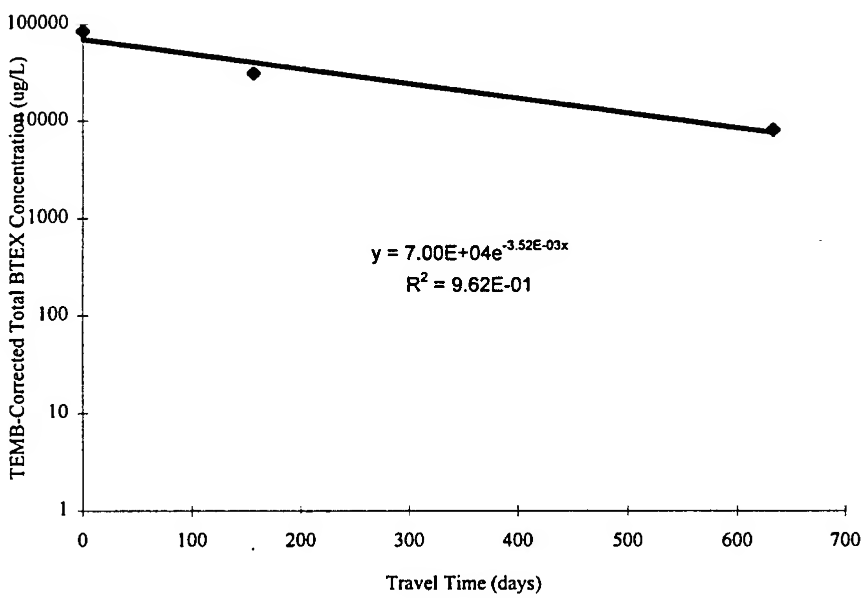
R_c 1.36 Coefficient of Retardation for Contaminant (Assume benzene

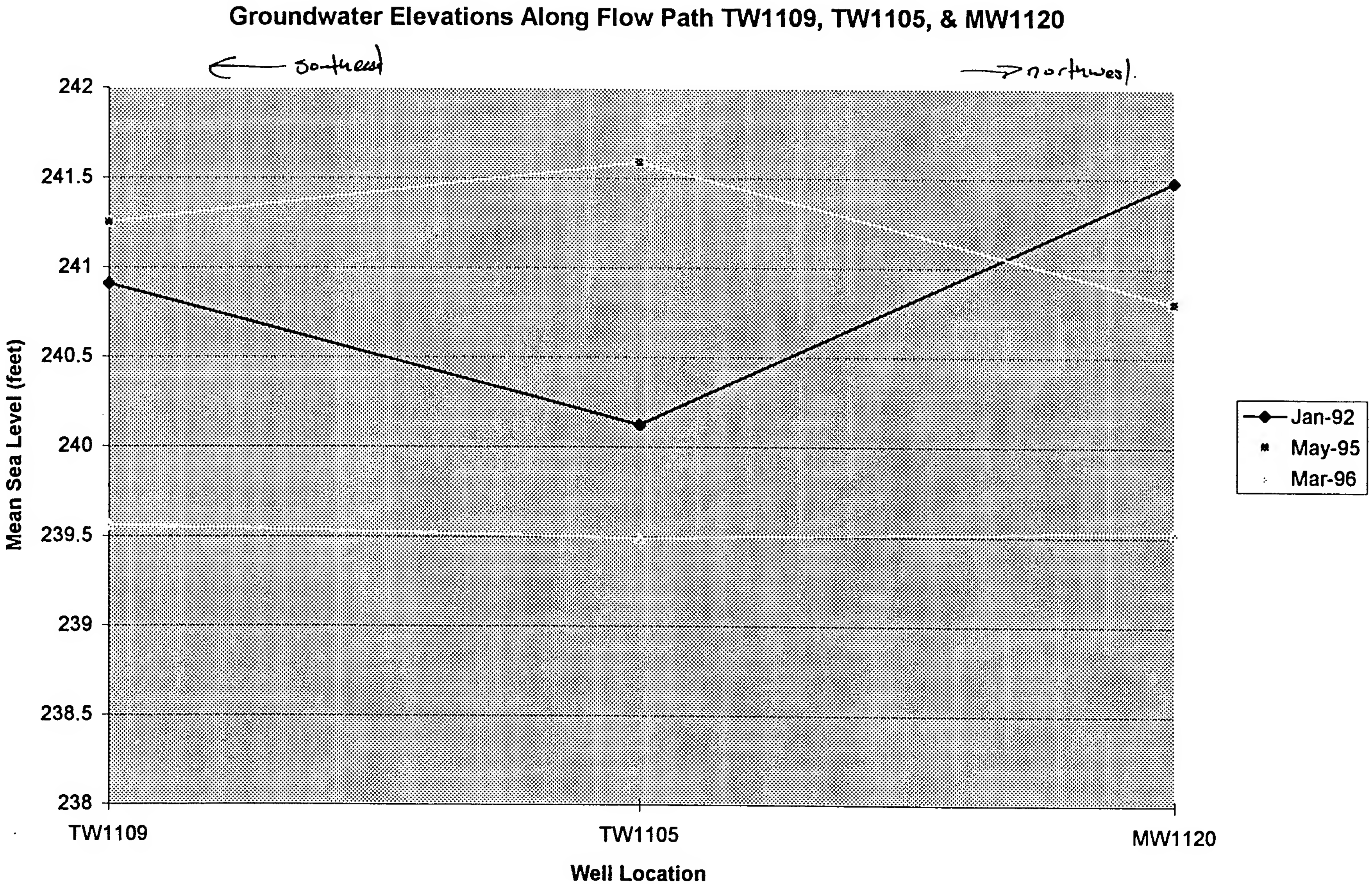
R_t = 28.72 Coefficient of Retardation for Tracer

*Equation used for total BTEX concentration correction shown in Section 5.3.5.1.

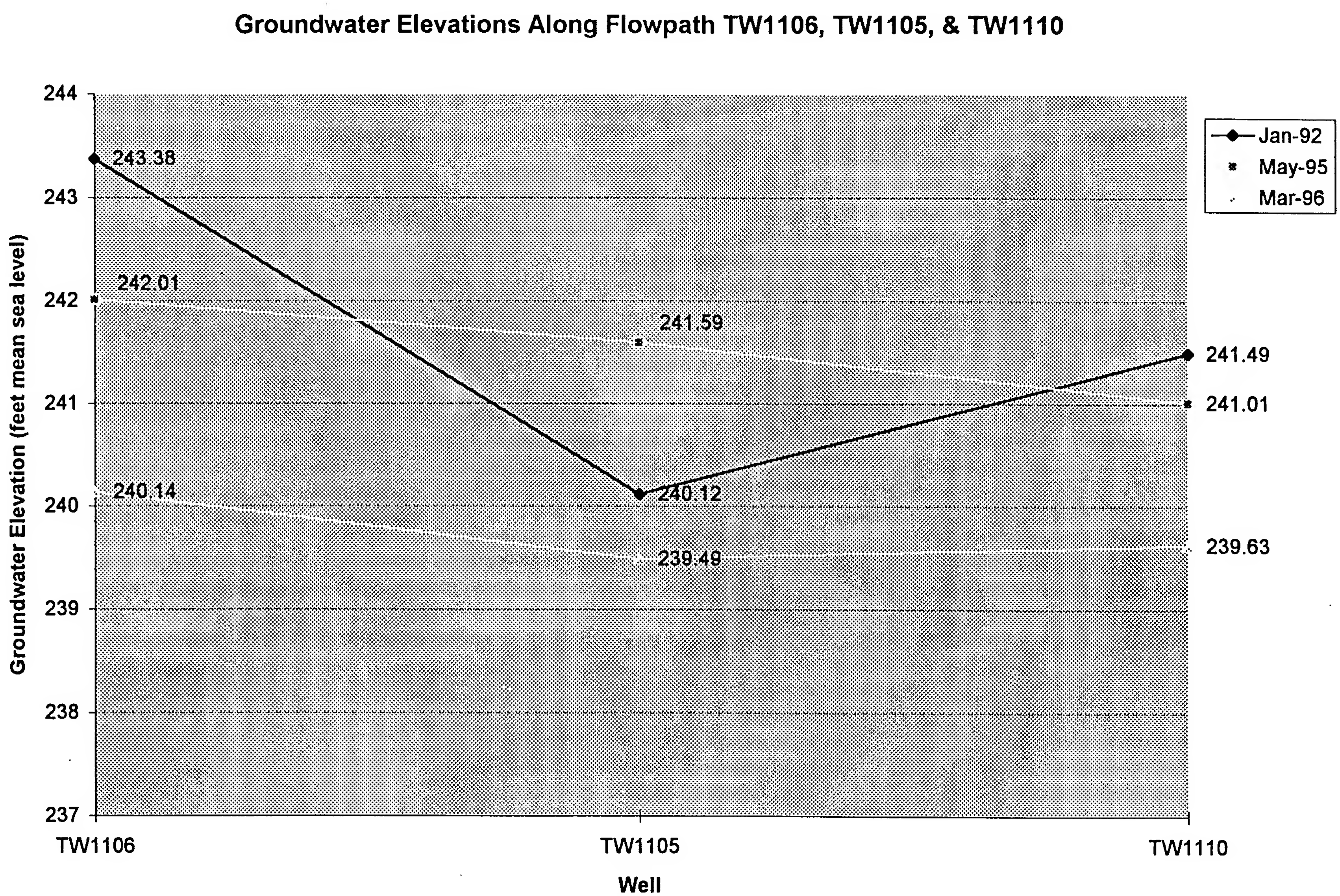
PLOT OF 1,2,3,4 TEMB-CORRECTED TOTAL BTEX CONCENTRATION VERSUS TIME

$$\frac{C_1}{C_0} = e^{-kt}$$





Groundwater Elevations Along Flow Path TW1109, TW1105, & MW1120
← southeast
→ northwest.
242
241.5
241
240.5
240
239.5
239
238.5
238
Mean Sea Level (feet)
TW1109
TW1105
MW1120
Well Location
Jan-92
May-95
Mar-96


Groundwater Elevations Along Flowpath TW1106, TW1105, & TW1110
Groundwater Elevation (feet mean sea level)
244
243
242
241
240
239
238
237
243.38
242.01
240.14
241.59
240.12
239.49
241.49
241.01
239.63
Jan-92
May-95
Mar-96
TW1106
TW1105
TW1110
Well

BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BX1SCAL
EAKER AFB
Run Name

Data Input Instructions:

.115	→ 1. Enter value directly....or
↑ or 0.02	2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
Variable*	→ Data used directly in model.
20	→ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	77.4	(ft/yr)
or		↑ or	
Hydraulic Conductivity	K	2.1E-03	(cm/sec)
Hydraulic Gradient	i	0.009	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	33.0	(ft)
Transverse Dispersivity*	alpha y	3.3	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		↑ or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		↑ or	
Soil Bulk Density	rho	1.65	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	2.3E+0	(per yr)
or		↑ or	
Solute Half-Life	t-half	0.31	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	33.78	(mg/L)
Delta Sulfate*	SO4	35.48	(mg/L)
Observed Methane*	CH4	3.8	(mg/L)

5. GENERAL

Modeled Area Length*	300	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	10	(yr)

L
W

6. SOURCE DATA

Source Thickness in Sat.Zone* 5 (ft)

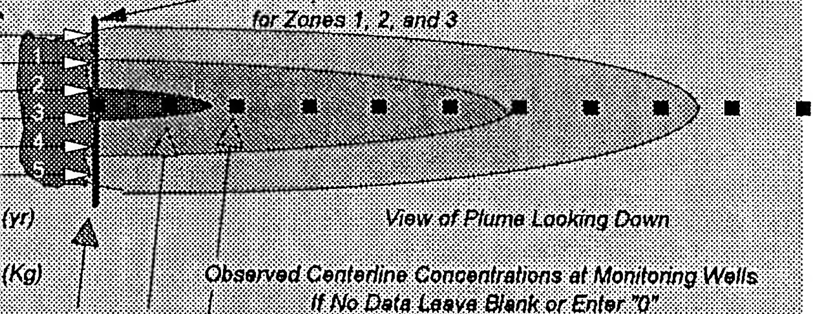
Source Zones:

Width* (ft)	Conc. (mg/L)*
50	0.1
25	5
100	84.9
25	5
50	0.1

Source Decay (see Help)

SourceHalflife*	Infinite	(yr)
Soluble Mass	↑ or	
In NAPL, Soil	Infinite	(Kg)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	84.9	30.5		7.8							.004
Dist. from Source (ft)	0	30	60	90	120	150	180	210	240	270	300

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE

View Output

RUN ARRAY

View Output

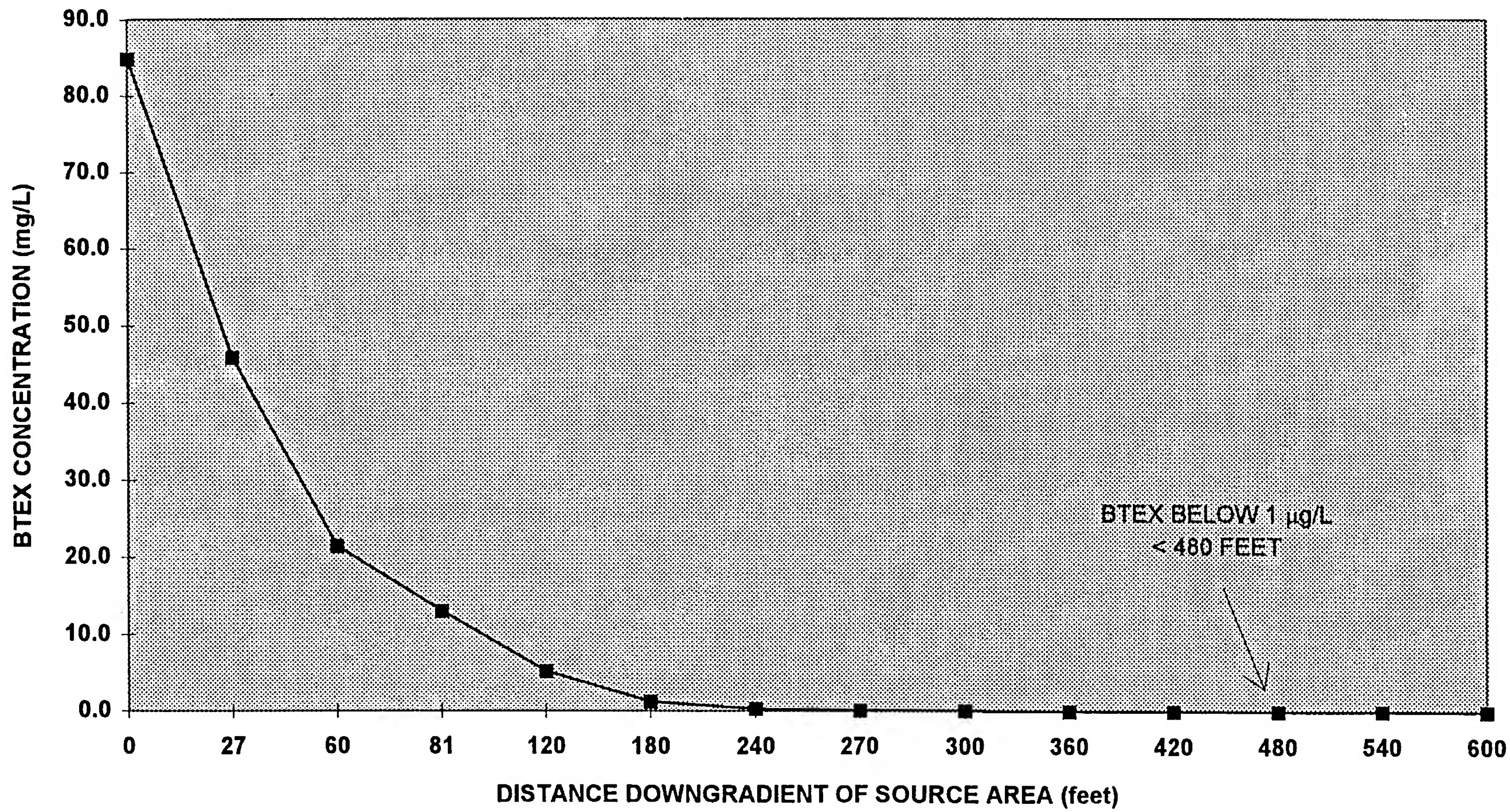
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

BTEX CONCENTRATIONS ALONG PLUME CENTERLINE
FOR MODEL CALIBRATION BX1SCAL
(ASSUMES EQUILIBRIUM CONDITIONS WITH A STEADY-STATE SOURCE)
BX SHOPPETTE (SITE EII)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS



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BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BXS1MODA
EAKER AFB
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ or 2. Calculate by filling in grey
0.02 cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.

20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	77.4	(ft/yr)
or		↑ or	
Hydraulic Conductivity	K	2.1E-03	(cm/sec)
Hydraulic Gradient	i	0.009	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	33.0	(ft)
Transverse Dispersivity*	alpha y	3.3	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		↑ or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		↑ or	
Soil Bulk Density	rho	1.65	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	2.3E+0	(per yr)
or		↑ or	
Solute Half-Life	t-half	0.31	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	33.78	(mg/L)
Delta Sulfate*	SO4	35.48	(mg/L)
Observed Methane*	CH4	3.8	(mg/L)

5. GENERAL

Modeled Area Length*	500	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	20	(yr)

L W

6. SOURCE DATA

Source Thickness in Sat.Zone* 5 (ft)

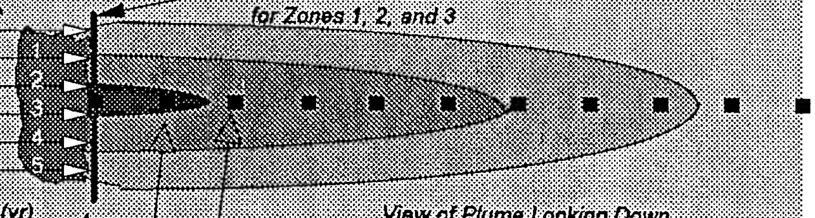
Source Zones:

Width* (ft)	Conc. (mg/L)*
50	0.1
25	5
100	84.9
25	5
50	0.1

Source Decay (see Help):

SourceHalflife*	10	(yr)
Soluble Mass	↑ or	
In NAPL, Soil	499	(Kg)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	84.9										
Dist. from Source (ft)	0	50	100	150	200	250	300	350	400	450	500

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | View Output

RUN ARRAY | View Output

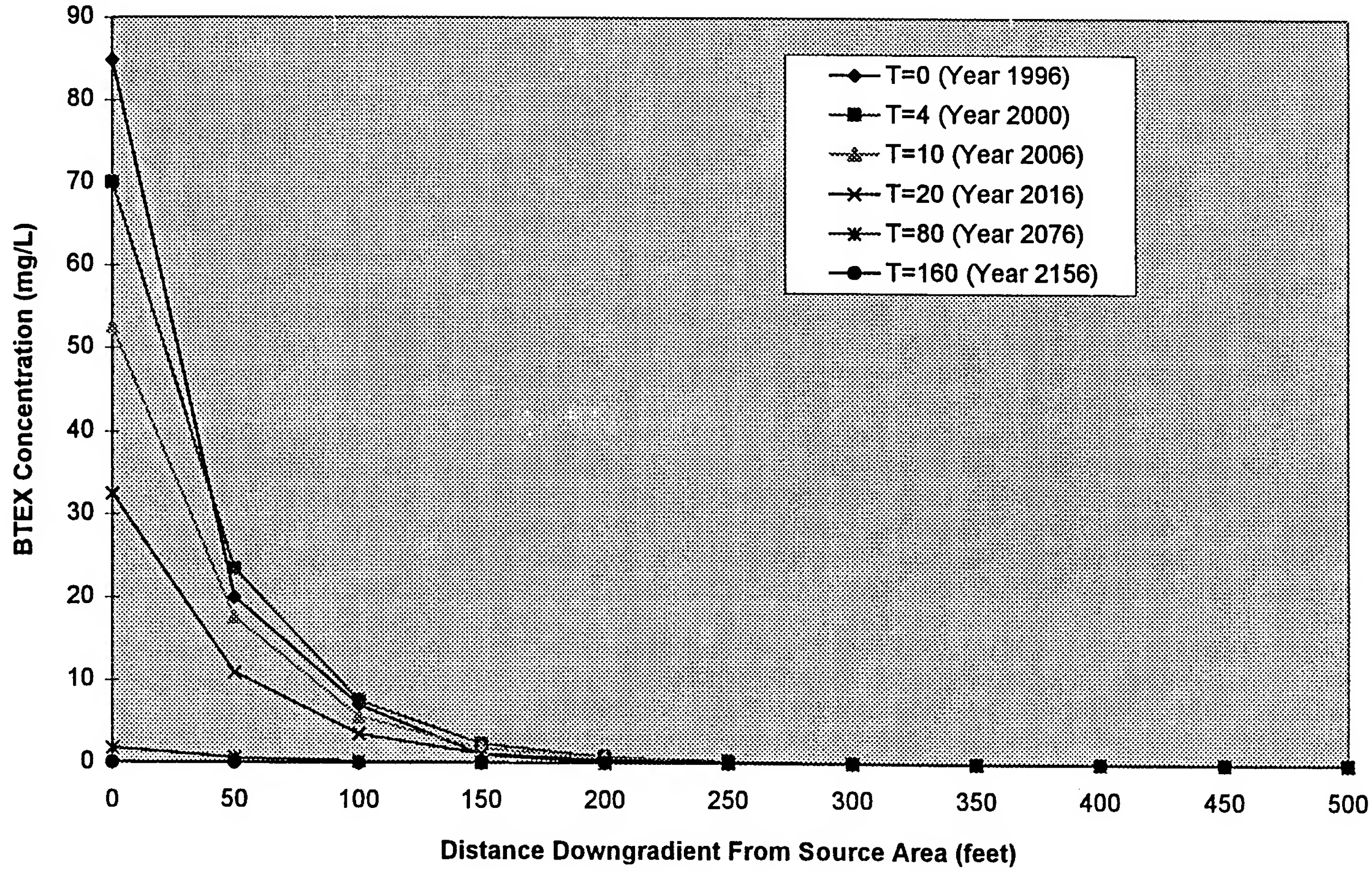
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

MODEL BX1SMODA
BTEX CONCENTRATION ALONG PLUME CENTERLINE VERSUS TIME
(SOURCE HALF-LIFE = 14 years)
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS



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BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BX1SMODB
EAKER AFB
Run Name

Data Input Instructions:

115 → 1. Enter value directly ...or
or 0.02 → 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.

20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	77.4	(ft/yr)
or		or	
Hydraulic Conductivity	K	2.1E-03	(cm/sec)
Hydraulic Gradient	i	0.009	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	33.0	(ft)
Transverse Dispersivity*	alpha y	3.3	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		or	
Soil Bulk Density	rho	1.65	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	2.3E+0	(per yr)
or		or	
Solute Half-Life	t-half	0.31	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	33.78	(mg/L)
Delta Sulfate*	SO4	35.48	(mg/L)
Observed Methane*	CH4	3.8	(mg/L)

5. GENERAL

Modeled Area Length*	500	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	20	(yr)

L W

6. SOURCE DATA

Source Thickness in Sat.Zone* 5 (ft)

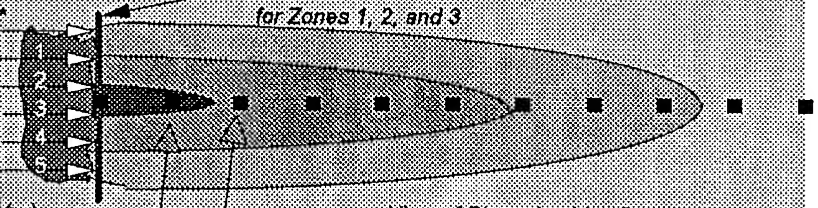
Source Zones:

Width* (ft)	Conc. (mg/L)*
50	0.1
25	5
100	84.9
25	5
50	0.1

Source Decay (see Help):

SourceHalflife*	2 - 3	(yr)
Soluble Mass	or	
In NAPL, Soil	104	(Kg)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	84.9										
Dist. from Source (ft)	0	50	100	150	200	250	300	350	400	450	500

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE

View Output

RUN ARRAY

View Output

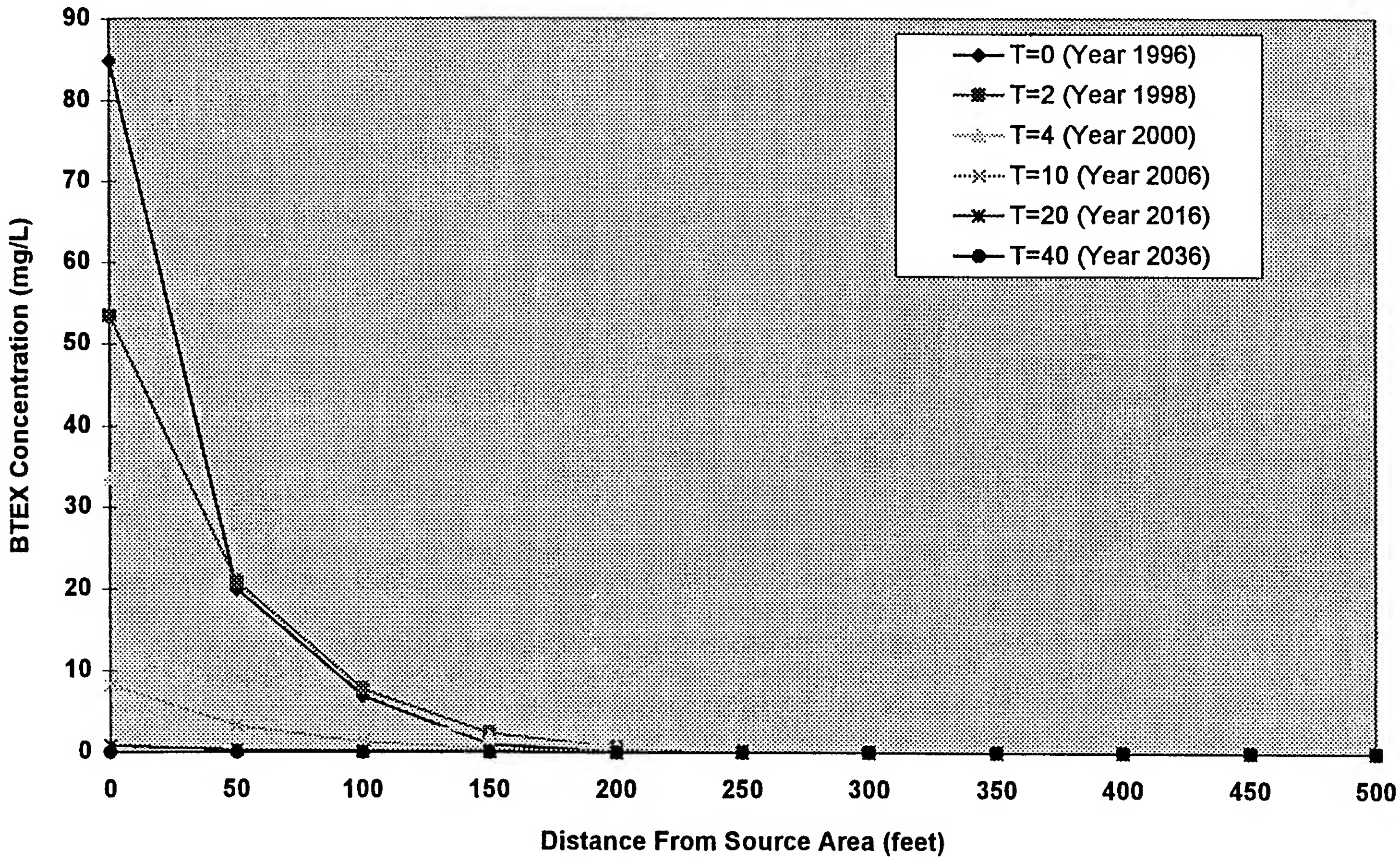
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

MODEL BX1SMODB
BTEX CONCENTRATION ALONG PLUME CENTERLINE
(20 PERCENT/YEAR SOURCE REDUCTION)
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS



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BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BX1SMODC
EAKER AFB
Run Name

Data Input Instructions:

115 → 1. Enter value directly ...or
or 0.02 → 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	77.4	(ft/yr)
or		or	
Hydraulic Conductivity	K	2.1E-03	(cm/sec)
Hydraulic Gradient	i	0.009	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	33.0	(ft)
Transverse Dispersivity*	alpha y	3.3	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		or	
Soil Bulk Density	rho	1.86	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	2.3E+0	(per yr)
or		or	
Solute Half-Life	t-half	0.31	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	33.78	(mg/L)
Delta Sulfate*	SO4	35.48	(mg/L)
Observed Methane*	CH4	3.8	(mg/L)

5. GENERAL

Modeled Area Length*	500	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	20	(yr)

L W

6. SOURCE DATA

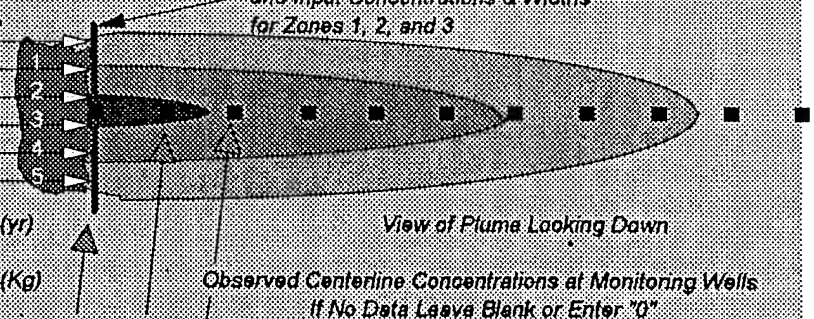
Source Thickness in Sat.Zone* 5 (ft)

Source Zones:

Width* (ft)	Conc. (mg/L)*
50	0.1
25	5
100	84.9
25	5
50	0.1

Source Decay (see Help):

SourceHalflife*	<1 - 1	(yr)
Soluble Mass	or	
In NAPL, Soil	35	(Kg)



7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	84.9										
Dist. from Source (ft)	0	50	100	150	200	250	300	350	400	450	500

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE

View Output

RUN ARRAY

View Output

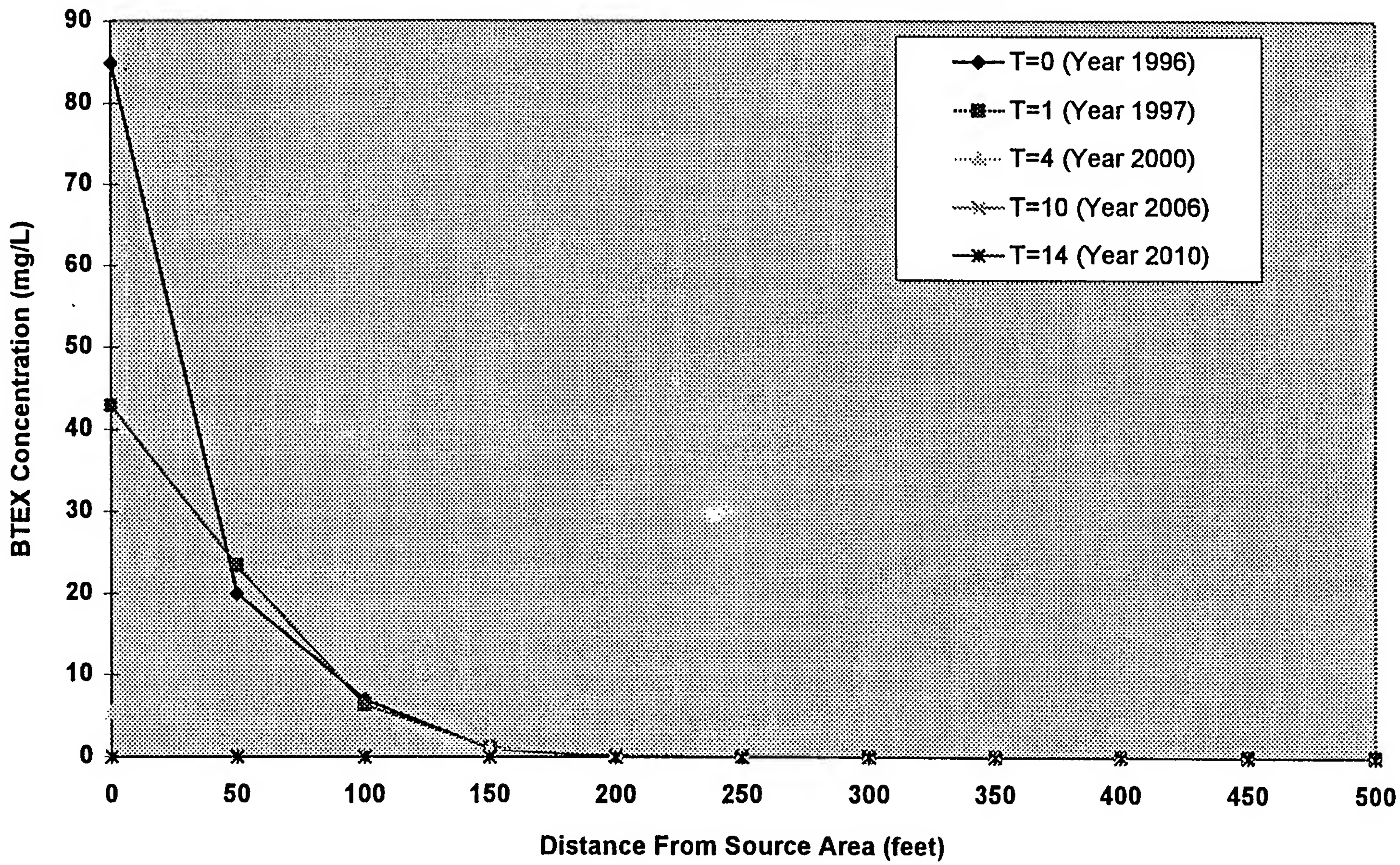
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

MODEL BX1SMODC
BTEX CONCENTRATION ALONG PLUME CENTERLINE
(50 PERCENT/YEAR SOURCE REDUCTION)
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS



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BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BX2SCAL
EAKER AFB
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or 0.02 → 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.

20 → Value calculated by model. (Don't enter any data)

1. HYDROGEOLOGY

Seepage Velocity*	Vs	77.4	(ft/yr)
or		or	
Hydraulic Conductivity	K	2.1E-03	(cm/sec)
Hydraulic Gradient	i	0.009	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	33.0	(ft)
Transverse Dispersivity*	alpha y	3.3	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		or	
Soil Bulk Density	rho	1.66	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	3.9E+0	(per yr)
or		or	
Solute Half-Life	t-half	0.18	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	33.78	(mg/L)
Delta Sulfate*	SO4	35.48	(mg/L)
Observed Methane*	CH4	3.8	(mg/L)

5. GENERAL

Modeled Area Length*	300	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	10	(yr)

L W

6. SOURCE DATA

Source Thickness in Sat.Zone* 5 (ft)

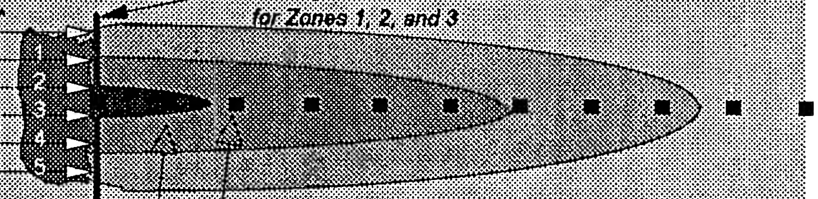
Source Zones:

Width* (ft)	Conc. (mg/L)*
50	0.1
25	5
100	84.9
25	5
50	0.1

Source Decay (see Help):

SourceHalflife*	Infinite	(yr)
Soluble Mass	or	
In NAPL, Soil	Infinite	(Kg)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	84.9	30.5		7.8							.004
Dist. from Source (ft)	0	30	60	90	120	150	180	210	240	270	300

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE

View Output

RUN ARRAY

View Output

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BX2SMODA
EAKER AFB
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or 0.02 → 2. Calculate by filling in grey cells below. (To restore formulas, hit button below)

Variable* → Data used directly in model.
20 → Value calculated by model (Don't enter any data)

1. HYDROGEOLOGY

Seepage Velocity*	Vs	77.4	(ft/yr)
or		or	
Hydraulic Conductivity	K	2.1E-03	(cm/sec)
Hydraulic Gradient	i	0.009	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	33.0	(ft)
Transverse Dispersivity*	alpha y	3.3	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		or	
Soil Bulk Density	rho	1.65	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	3.9E+0	(per yr)
or		or	
Solute Half-Life	t-half	0.18	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	33.78	(mg/L)
Delta Sulfate*	SO4	35.48	(mg/L)
Observed Methane*	CH4	3.8	(mg/L)

5. GENERAL

Modeled Area Length*	500	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	20	(yr)

6. SOURCE DATA

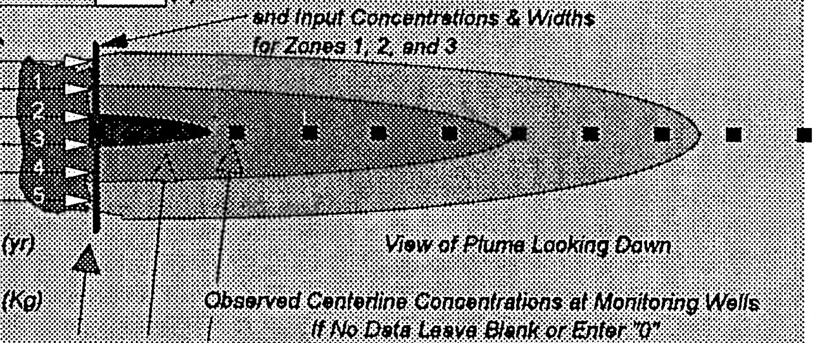
Source Thickness in Sat.Zone* 5 (ft)

Source Zones:

Width* (ft)	Conc. (mg/L)*
50	0.1
25	5
100	84.9
25	5
50	0.1

Source Decay (see Help):

SourceHalflife*	10	(yr)
Soluble Mass	or	
In NAPL, Soil	499	(Kg)



7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	84.9										
Dist. from Source (ft)	0	50	100	150	200	250	300	350	400	450	500

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE

View Output

RUN ARRAY

View Output

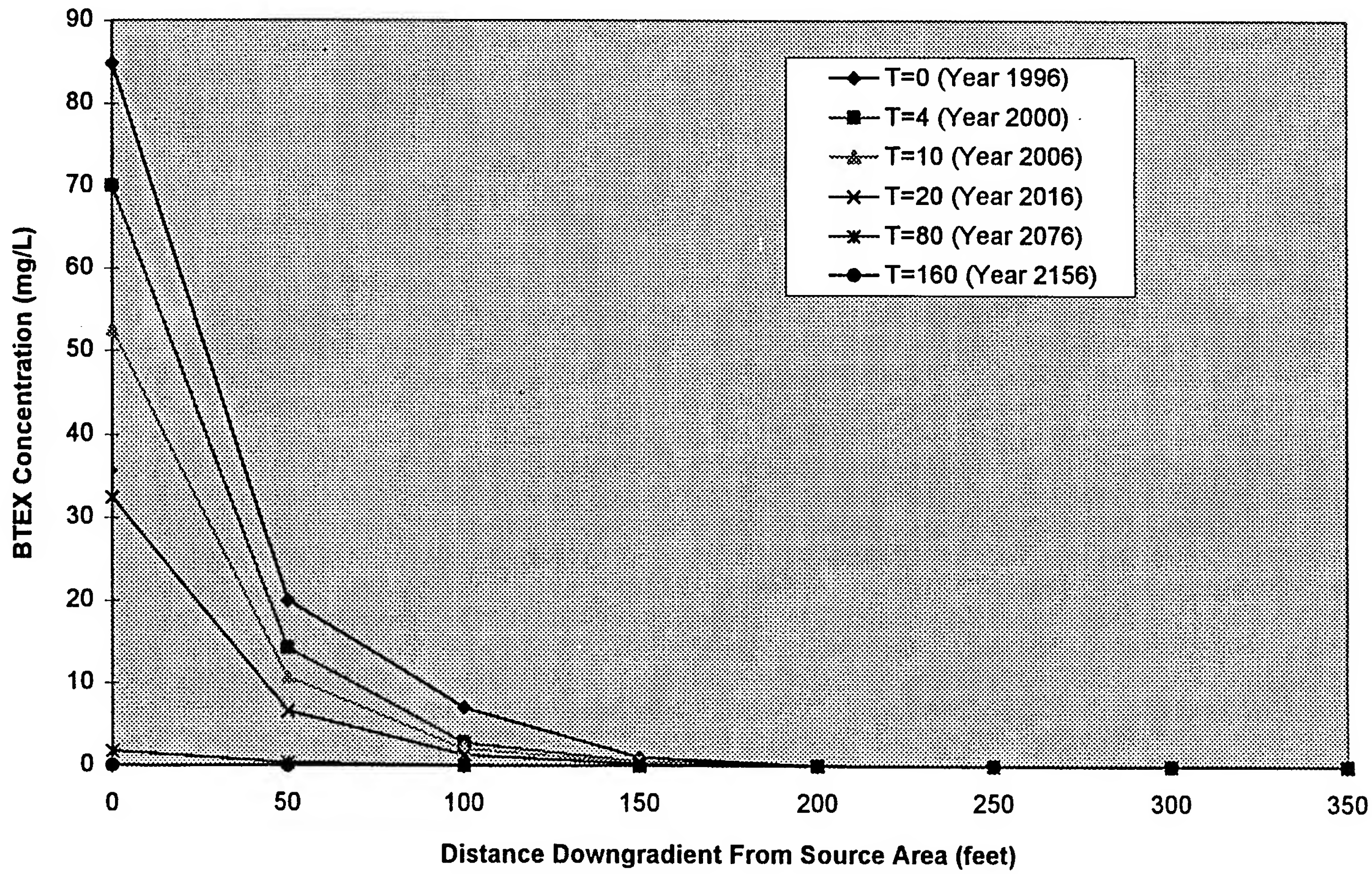
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

MODEL BX2SMODA
BTEX CONCENTRATION ALONG PLUME CENTERLINE VERSUS TIME
(5 PERCENT/YEAR SOURCE REDUCTION)
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS



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BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BX2SMODB
EAKER AFB
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
0.02

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data)

1. HYDROGEOLOGY

Seepage Velocity*	Vs	77.4	(ft/yr)
or		or	
Hydraulic Conductivity	K	2.1E-03	(cm/sec)
Hydraulic Gradient	i	0.009	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	33.0	(ft)
Transverse Dispersivity*	alpha y	3.3	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		or	
Soil Bulk Density	rho	1.65	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	3.9E+0	(per yr)
or		or	
Solute Half-Life	t-half	0.18	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	33.78	(mg/L)
Delta Sulfate*	SO4	35.48	(mg/L)
Observed Methane*	CH4	3.8	(mg/L)

5. GENERAL

Modeled Area Length*	500	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	20	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 5 (ft)

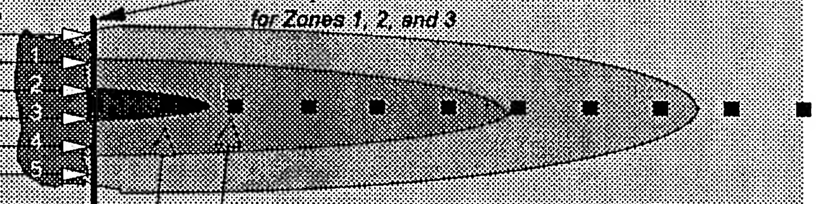
Source Zones:

Width* (ft)	Conc. (mg/L)*
50	0.1
25	5
100	84.9
25	5
50	0.1

Source Decay (see Help):

SourceHalflife*	2 - 3	(yr)
Soluble Mass	or	
In NAPL, Soil	104	(Kg)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	84.9										
Dist. from Source (ft)	0	50	100	150	200	250	300	350	400	450	500

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE

View Output

RUN ARRAY

View Output

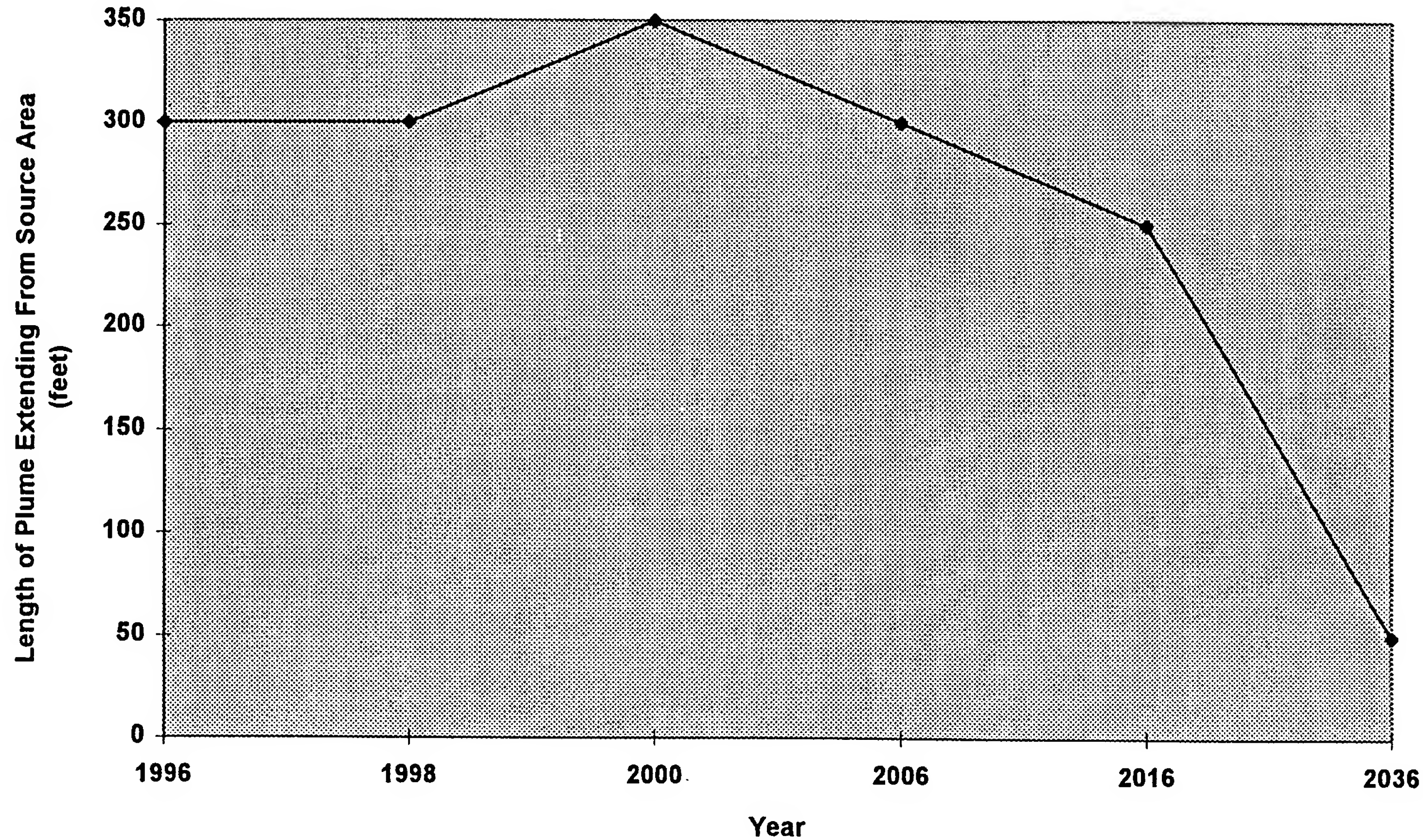
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

MODEL BX2SMODB
BTEX PLUME LENGTH
(DEFINED BY 1 ug/L BTEX)
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS



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BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BX2SMODC
EAKER AFB
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or 0.02 → 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	77.4	(ft/yr)
or		or	
Hydraulic Conductivity	K	2.1E-03	(cm/sec)
Hydraulic Gradient	i	0.009	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	33.0	(ft)
Transverse Dispersivity*	alpha y	3.3	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		or	
Soil Bulk Density	rho	1.65	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	3.9E+0	(per yr)
or		or	
Solute Half-Life	t-half	0.18	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	33.78	(mg/L)
Delta Sulfate*	SO4	35.48	(mg/L)
Observed Methane*	CH4	3.8	(mg/L)

5. GENERAL

Modeled Area Length*	500	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	20	(yr)

L W

6. SOURCE DATA

Source Thickness in Sat.Zone* 5 (ft)

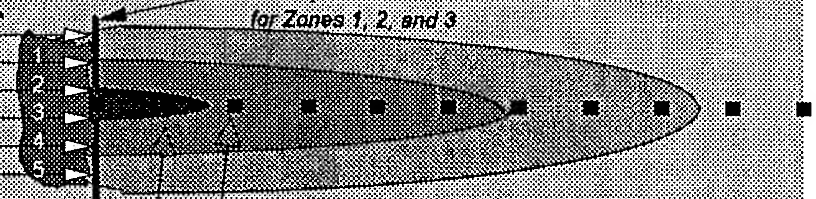
Source Zones:

Width* (ft)	Conc. (mg/L)*
50	0.1
25	5
100	84.9
25	5
50	0.1

Source Decay (see Help):

SourceHalflife*	<1 - 1	(yr)
Soluble Mass	or	
In NAPL, Soil	35	(Kg)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	84.9										
Dist. from Source (ft)	0	50	100	150	200	250	300	350	400	450	500

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | View Output

RUN ARRAY | View Output

Help

Recalculate This Sheet

Paste Example Dataset

R··ore Formulas for Vs, Dispersivities, R, lambda, other

MODEL BX2SMODC

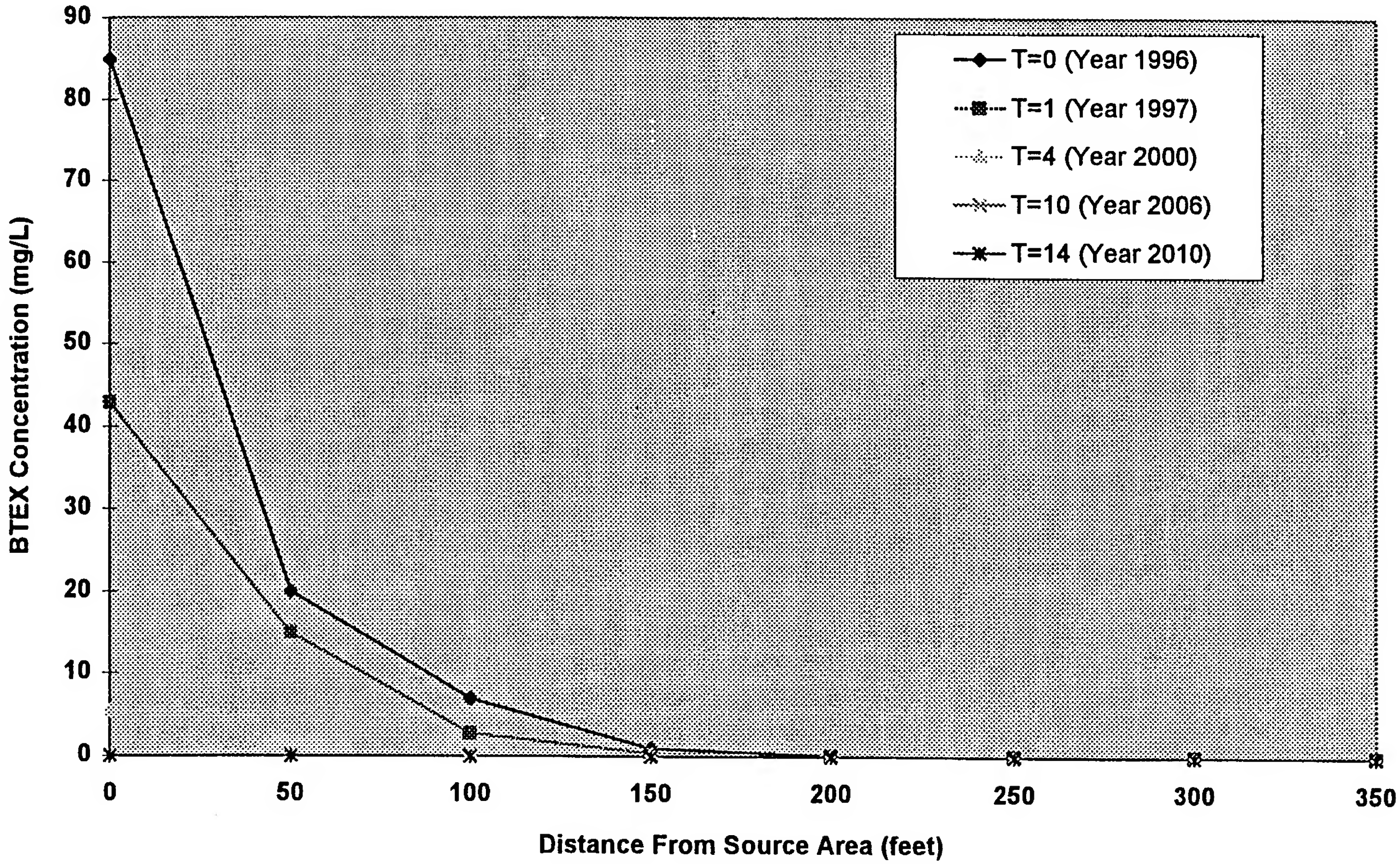
BTEX CONCENTRATION ALONG PLUME CENTERLINE

(50 PERCENT/YEAR SOURCE REDUCTION)

BX SHOPPETTE (SITE E11)

DEMONSTRATION OF RNA

EAKER AIR FORCE BASE, ARKANSAS



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BIOSCREEN Intrinsic Remediation Decision Support System

About BIOSCREEN

Version 1.2

BX1DCAL
EAKER AFB
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
0.02

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	1.3	(ft/yr)
or		or	
Hydraulic Conductivity	K	1.2E-03	(cm/sec)
Hydraulic Gradient	i	0.00026	(ft/ft)
Porosity	n	0.25	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	1.5	(ft)
Transverse Dispersivity*	alpha y	0.2	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	1.4	(-)
or		or	
Soil Bulk Density	rho	1.65	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	0.0007	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	3.7E-2	(per yr)
or		or	
Solute Half-Life	t-half	18.98	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	2.1	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	19.6	(mg/L)
Delta Sulfate*	SO4	65.2	(mg/L)
Observed Methane*	CH4	3	(mg/L)

5. GENERAL

Modeled Area Length*	200	(ft)
Modeled Area Width*	60	(ft)
Simulation Time*	20	(yr)

L W

6. SOURCE DATA

Source Thickness in Sat.Zone* 16 (ft)

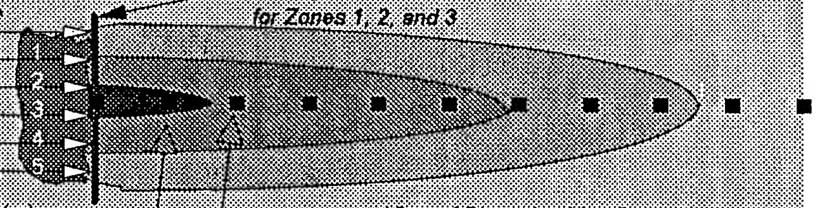
Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
0	0
60	100
0	0
0	0

Source Decay (see Help):

SourceHalflife*	Infinite	(yr)
Soluble Mass	or	
In NAPL, Soil	Infinite	(Kg)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)	0	20	40	60	80	100	120	140	160	180	200

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE

View Output

RUN ARRAY

View Output

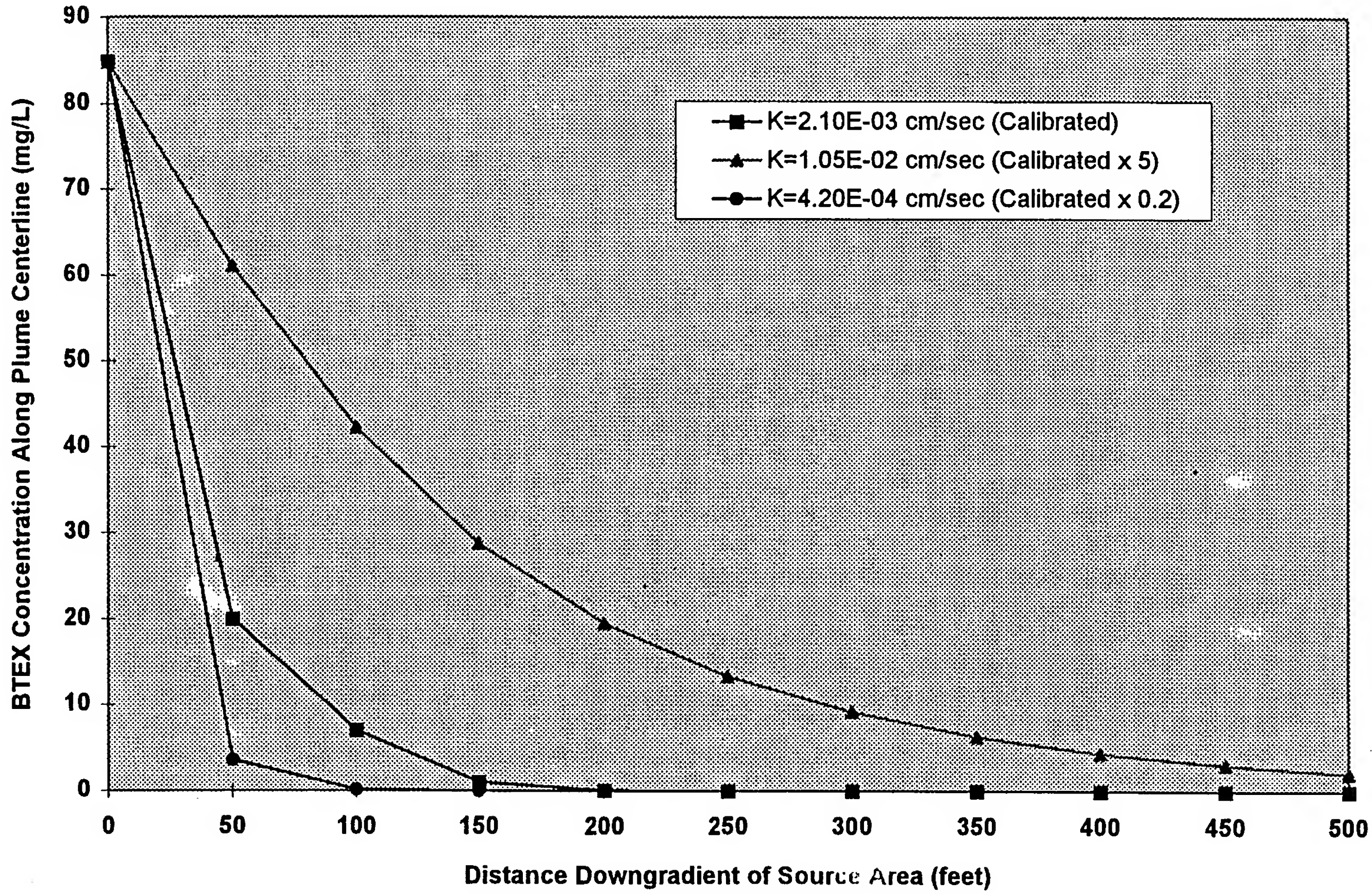
Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

MODEL SENSITIVITY TO VARIATIONS IN HYDRAULIC CONDUCTIVITY
BX SHOPPETTE (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS



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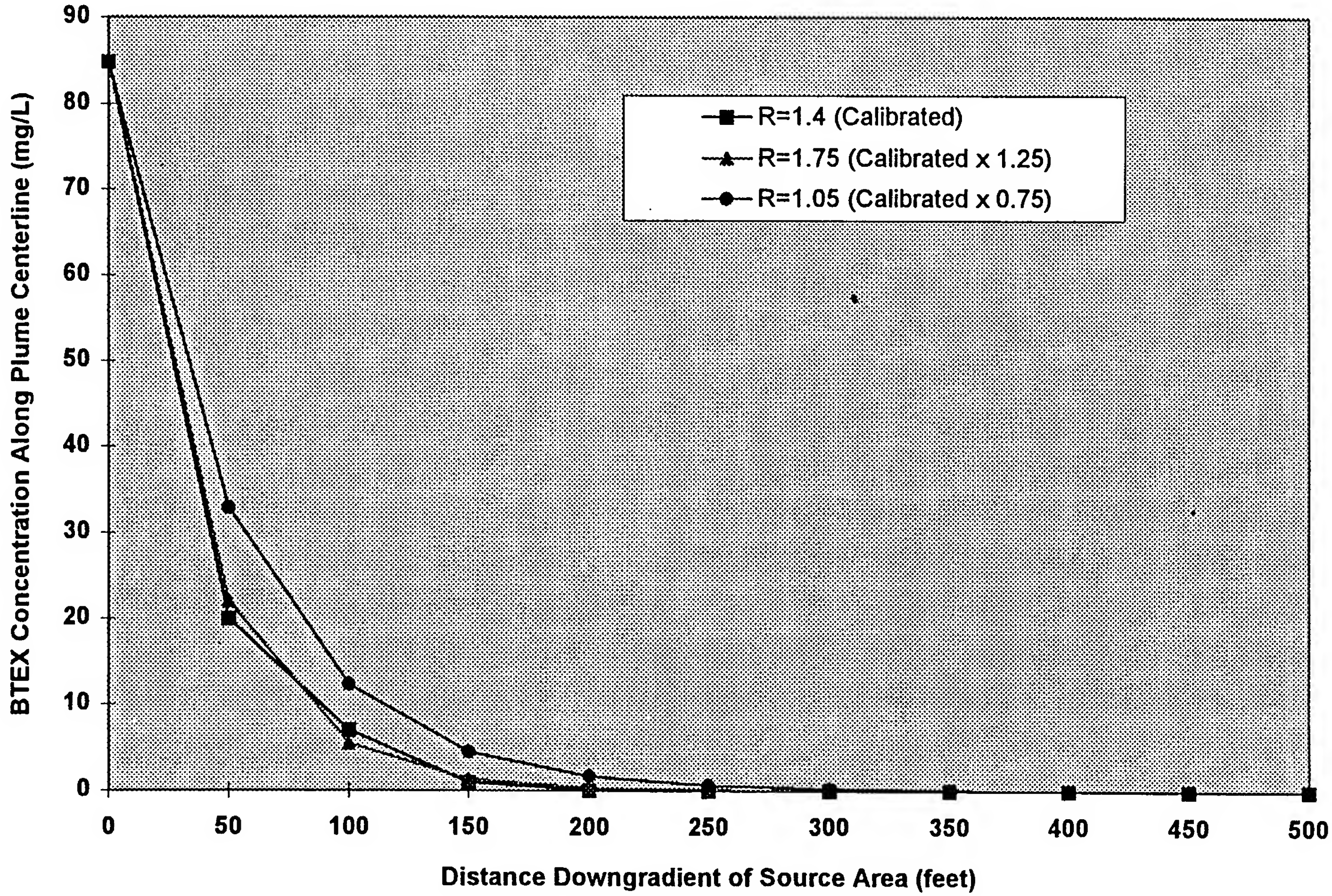
MODEL SENSITIVITY TO VARIATIONS IN RETARDATION
BX SERVICE STATION (SITE E11)
DEMONSTRATION OF RNA
EAKER AIR FORCE BASE, ARKANSAS



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APPENDIX E

BIOSCREEN MODEL INPUT AND OUTPUT FOR USE IN A MICROSOFT® EXCEL SPREADSHEET ENVIRONMENT

APPENDIX F

CALCULATIONS FOR REMEDIAL OPTION DESIGN AND COSTING.

Present Worth Analysis

Annual Adjustment Factor = 7%

Alternative 3: Continued Biioslurping, Source Excavation, Remediation by Natural Attenuation, Institutional Controls, & Long-Term Monitoring		Present Worth	Cost ($) at Year Indicated							
	years	($)	Year: 1	2	3	4	5	10	15	20
Maintain Institutional Controls	15	$48,727	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$0
Long-term Monitoring										
Install New Wells	1	$14,021	$15,002	$0	$0	$0	$0	$0	$0	$0
Groundwater Sampling	15	$87,846	$11,060	$11,060	$11,060	$11,060	$11,060	$11,060	$11,060	$0
Reporting/Project Mgmt	15	$97,409	$10,695	$10,695	$10,695	$10,695	$10,695	$10,695	$10,695	$0
Subtotal Present Worth ($)		$248,003								
Bioslurping (Assume Cont. Op. For 1 year)										
Bioslurping System Installation	1	$0	$0							
System Maintenance	1	$0	$0	$0	$0	$0	$0	$0	$0	$0
Reporting Costs	1	$0	$0	$0	$0	$0	$0	$0	$0	$0
		$0								
Excavation										
Excavation	1	$26,125	$0	$29,910	$0	$0	$0	$0	$0	$0
Annual Tilling/Sampling	4	$48,392	$0	$18,440	$18,440	$18,440	$0	$0	$0	$0
Reporting Costs	4	$17,153	$0	$6,536	$6,536	$6,536	$0	$0	$0	$0
Clearance Sampling	1	$4,694	$0	$0	$0	$5,750	$0	$0	$0	$0
		$91,670								

Total Present Worth Cost ($): $339,673

Alternatives 1 to 2: Long-Term Monitoring and Institutional Controls

Standard Rate Schedule

Billing Category Cost Code/(Billing Category)		Billing Rate	Task 1 (hrs)	Install New LTM/POC Wells ($)	Task 2 (hrs)	Sampling ($)	Task 3 (hrs)	Reporting & PM ($)
Word Processor	88/(15)	$30	0	$0	0	$0	30	$900
CADD Operator	58/(25)	$47	6	$282	0	$0	30	$1,410
Technician	42/(50)	$40	24	$960	40	$1,600	30	$1,200
Staff Level	16/(65)	$57	40	$2,280	40	$2,280	60	$3,420
Project Level	12/(70)	$65	8	$520	4	$260	40	$2,600
Senior Level	10/(80)	$85	1	$85	0	$0	3	$255
Principal	02/(85)	$97	0	$0	0	$0	0	$0
Total Labor (hrs|$)			79	$4,127	84	$4,140	193	$9,785
ODCs								
Phone				$200		$0		$100
Photocopy				$200		$0		$200
Mail				$100		$400		$60
Computer				$150		$0		$250
CAD				$50		$0		$200
WP				$25		$0		$100
Travel				$1,000		$2,000		$0
Per Diem				$700		$360		$0
Eqpt. & Supplies				$500		$200		$0
Total ODCs				$2,925		$2,960		$910
Outside Services								
LTM/POC Well Installation Costs [a/]				$5,850		$0		$0
Laboratory Fees [b/]			Soils	$600	6 LTM, 5 POC,	$3,960		
Other: Maintain Institutional Controls				$0	3 SW, 5 qa/qc			$5,000
Total Outside Services				$6,450		$3,960		$5,000

Proposal Estimate	Task 1	Task 2	Task 3
Labor	$4,127	$4,140	$9,785
ODC's	$2,925	$2,960	$910
Outside Services	$6,450	$3,960	$5,000
Total by Task	$13,502	$11,060	$15,695

Total Labor	$18,052
Total ODCs	$6,795
Total Outside Services	$15,410
Total Project	$40,257

Task 1: Install New LTM/POC Wells

Task 2: Sampling per Event

Task 3: Reporting and PM per Sampling Event

[a/] 5 Wells, 75ft @ $50/ft, $2000mob, $100 soil handling

[b/] (BTEX @ $120ea (SW8020) and electron acceptors at @ $150ea at LTM/POC wells.

Present Worth Analysis

Annual Adjustment Factor = 7%

Alternative 2: Continued Bioslurping, Bioventing, Remediation by Natural Attenuation, Institutional Controls, and Long-Term Monitoring		Present Worth	Cost ($) at Year Indicated							
	years	($)	Year: 1	2	3	4	5	10	15	20
Maintain Institutional Controls	15	$48,727	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$0
Long-term Monitoring										
Install New Wells	1	$13,502	$13,502	$0	$0	$0	$0	$0	$0	$0
Groundwater Sampling	15	$107,785	$11,060	$11,060	$11,060	$11,060	$11,060	$11,060	$11,060	$0
Reporting/Project Mgmt	15	$104,228	$10,695	$10,695	$10,695	$10,695	$10,695	$10,695	$10,695	$0
Subtotal Present Worth ($)		$274,242								
Bioslurping										
System Maintenance	1	$0	$0	$0	$0	$0	$0	$0	$0	$0
Reporting Costs	1	$0	$0	$0	$0	$0	$0	$0	$0	$0
		$0								
Bioventing										
Bioventing System Installation	1	$69,226	$0	$74,071	$0	$0	$0	$0	$0	$0
System Maintenance	4	$41,256	$0	$12,180	$12,180	$12,180	$12,180	$0	$0	$0
Reporting Costs	4	$14,721	$0	$4,346	$4,346	$4,346	$4,346	$0	$0	$0
		$125,203								

Total Present Worth Cost ($): $399,445

Present Worth Analysis 0.07 Annual Adjustment Factor = 7%

Alternative 1: Continued Bioslurping, Remediation by Natural Attenuation, Institutional Controls, and Long-Term Monitoring		Present Worth	Cost ($) at Year Indicated							
	years	($)	Year: 1	2	3	4	5	10	15	20
Maintain Institutional Controls	20	$56,678	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Long-term Monitoring										
Install New Wells	1	$13,502	$13,502	$0	$0	$0	$0	$0	$0	$0
Groundwater Sampling	20	$125,372	$11,060	$11,060	$11,060	$11,060	$11,060	$11,060	$11,060	$11,060
Reporting/Project Mgmt	20	$121,234	$10,695	$10,695	$10,695	$10,695	$10,695	$10,695	$10,695	$10,695
Subtotal Present Worth ($)		$316,786								
Bioslurping										
System Maintenance	1	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Report	1	$0	$0	$0	$0	$0	$0	$0	$0	$0
		$0								

Total Present Worth Cost ($): $316,786

Alternative 3: Long-Term Monitoring and Institutional Controls

Standard Rate Schedule

Billing Category Cost Code/(Billing Category)		Billing Rate	Task 1 (hrs)	Install New LTM/POC Wells ($)	Task 2 (hrs)	Sampling ($)	Task 3 (hrs)	Reporting & PM ($)
Word Processor	88/(15)	$30	0	$0	0	$0	30	$900
CADD Operator	58/(25)	$47	6	$282	0	$0	30	$1,410
Technician	42/(50)	$40	24	$960	40	$1,600	30	$1,200
Staff Level	16/(65)	$57	40	$2,280	40	$2,280	60	$3,420
Project Level	12/(70)	$65	8	$520	4	$260	40	$2,600
Senior Level	10/(80)	$85	1	$85	0	$0	3	$255
Principal	02/(85)	$97	0	$0	0	$0	0	$0
Total Labor (hrs|$)			79	$4,127	84	$4,140	193	$9,785
ODCs								
Phone				$200		$0		$100
Photocopy				$200		$0		$200
Mail				$100		$400		$60
Computer				$150		$0		$250
CAD				$50		$0		$200
WP				$25		$0		$100
Travel				$1,000		$2,000		$0
Per Diem				$700		$360		$0
Eqpt. & Supplies				$500		$200		$0
Total ODCs				$2,925		$2,960		$910
Outside Services								
LTM/POC Well Installation Costs [a]				$7,350		$0		$0
Laboratory Fees [b]			Soils	$600	6 LTM, 5 POC, 3 SW, 5 qa/qc	$3,960		
Other: Maintain Institutional Controls				$0				$5,000
Total Outside Services				$7,950		$3,960		$5,000

Proposal Estimate	Task 1	Task 2	Task 3
Labor	$4,127	$4,140	$9,785
ODC's	$2,925	$2,960	$910
Outside Services	$7,950	$3,960	$5,000
Total by Task	$15,002	$11,060	$15,695

Total Labor	$18,052
Total ODCs	$6,795
Total Outside Services	$16,910
Total Project	$41,757

Task 1: Install New LTM/POC Wells
Task 2: Sampling per Event
Task 3: Reporting and PM per Sampling Event

[a] 5 Wells, 75ft @ $50/ft, $2000mob, $100 soil handling
[b] (BTEX @ $120ea (SW8020) and electron acceptors at @ $150ea at LTM/POC wells.

Alternative 2: Bioventing

Standard Rate Schedule

Billing Category Cost Code/(Billing Category)		Billing Rate	Task 1 (hrs)	Design & Install Biovent. System ($)	Task 2 (hrs)	System Monitoring/ Maintenance (2x per yr)($)	Task 3 (hrs)	End of Year Report ($)
Word Processor	88/(15)	$30	40	$1,200	0	$0	8	$240
CADD Operator	58/(25)	$47	100	$4,700	0	$0	8	$376
Technician	42/(50)	$40	160	$6,400	60	$2,400	8	$320
Staff Level	16/(65)	$57	200	$11,400	60	$3,420	40	$2,280
Project Level	12/(70)	$65	100	$6,500	10	$650	8	$520
Senior Level	10/(80)	$85	8	$680	0	$0	2	$170
Principal	02/(85)	$97	1	$97	0	$0	0	$0
Total Labor (hrs|$)			609	$30,977	130	$6,470	74	$3,906
ODCs								
Phone				$100		$50		$20
Photocopy				$500		$10		$100
Mail				$200		$50		$40
Computer				$500		$0		$200
CAD				$500		$0		$40
WP				$200		$0		$40
Travel				$2,000		$2,000		$0
Per Diem				$4,578		$1,000		$0
Eqpt. & Supplies				$2,000		$400		$0
Total ODCs				$10,578		$3,510		$440
Outside Services								
Well Installation				$9,206		$0		$0
System Installation				$18,810		$0		$0
Equipment Costs				$2,500		$0		$0
Product Hauling/Disposal (Soil)				$500		$0		$0
Electrical Costs				$0		$200		$0
Laboratory Fees				$1,500		$2,000		$0
Other				$0		$0		$0
Total Outside Services				$32,516		$2,200		$0

Estimate	Task 1	Task 2	Task 3
Labor	$30,977	$6,470	$3,906
ODC's	$10,578	$3,510	$440
Outside Services	$32,516	$2,200	$0
Total by Task	$74,071	$12,180	$4,346

Total Labor	$41,353
Total ODCs	$14,528
Total Outside Services	$34,716
Total Project	$90,597

Task 1: Bioventing System Design and Construction
Task 2: Monthly Site Time and Travel Costs (per year)
Task 3: Report Preparation

Eaker Air Force Base, BX Shoppette, Backup Calculations

Alternatives 1 : Long-term Monitoring and Continued Bioslurping (Bioslurper Already Installed)

Misc calculations

Number of LTM wells:		
Number of wells:	5	
Depth each:	15	ft

Cost calculations

Description	Unit	Qty.	Unit Price	Subtotal	Total	Source (If applicable)
Well Installation					$ 5,850	
Mobilization	ea	1	$ 2,000	$ 2,000		
Well Installation	ln ft	75	$ 50	$ 3,750		
Soil Disposal	cy	1	$ 100	$ 100		*assumes disposal at nearby land treatment farm
Product Hauling/ Disposal (Fuel(ann))	gal	600	$0.25	$ 150	$ 150	
Wastewater Disposal	gal	50,000	$0.05	$ 2,500	$ 2,500	land treatment farm

Alternative 2: Bioventing (Bioslurper Already Installed)

Misc calculations

Vent Wells		
Number of wells:	6	
Depth each:	10	ft
(assume 20' radius of influence)		
Volume	1	cy
Soil Gas Points		
Number of Points	24	
Average Point Depth	5	
Trench Volume/Area		
Width:	12	in
Depth:	1	ft
Length:	500	ft
Volume:	500	cf
	19	cy
Surface Area:	500	sf
	56	sy

Cost calculations

Description	Unit	Qty.	Unit Price	Subtotal	Total	Source (If applicable)
Vent Well Installation					$ 9,206	
Mobilization	ea	1	$ 2,000	$ 2,000		
Well Installation	ln ft	60	$ 60	$ 3,600		
Point Installation	ln ft	120	$30	$ 3,600		
Soil Disposal	cy	1	$ 8	$ 6		
Equipment Costs					$ 2,500	
Blower	ea	1	$ 2,000	$ 2,000		Recovery Equipment Supply
Blower House	ea	1	$ 500	$ 500		
System Installation					$ 18,810	
Mob/Demob	ea	1	$ 1,000	$ 1,000		
Trenching	cy	500	$ 5.05	$ 2,525		Means 022 254 0050
Pipe laying	ln ft	1	$ 2.50	$ 3		Means 151 701 0550/026 686 2800
Backfill	cy	500	$ 17.20	$ 8,600		Means 022 204 0600
Compaction	cy	500	$ 5.10	$ 2,550		Means 022 204 0600
Pavement Base	sy	56	$ 5.25	$ 294		Means 022 308 0100
Reseeding	sy	-	$ 1.91	$ -		Means 029 304 0310
Piping	lf	700	$ 1.00	$ 700		Means 151 551 1880
Mechanical	man hr	32	$ 38.83	$ 1,243		Means Q-1 crew
Electrical	ls	1	$ 1,000	$ 1,000		Adjacent to Powered Building
Slab	cy	-	$ 97.00	$ -		Means 033 130 4700
Contingency	%	5%	$ 17,915	$ 896		
Product Hauling	cy	1	$ 500	$ 500	$ 500	Soil Transport and Disposal May
/Disposal (Soil)	cy	1	$ 500	$ 500	$ 500	Be Performed at Adjacent Land-Farm, assume reduced costs

Alternative 3: Excavation

Misc calculations

Excavation Volume/Area		
Radius*	40	ft
Depth:	9	ft
Volume:	45,239	cf
	1,676	cy
Surface Area:	5,027	sf
	559	sy

*This radius was estimated to include an area equivalent for both the north and south source area

Cost calculations

Description	Unit	Qty.	Unit Price	Subtotal	Total	Source (If applicable)
					$ 12,447	
Soil Excavation/ Transportation/ Backfill	cy	1,676	$3.62	$ 6,067		*Costs of Exctraction, Trans., and Backfill estimated by R & R International, Inc., Akron, Ohio.
Replace Asphalt & Subbase	sy	559	$6.40	$ 3,578		Assume one soil sample per 100 yards.
Sampling (8015)	each	17	$130.00	$ 2,210		
Contingency	%	5%	$11854.72	$ 593		

Note! Assume backfill purchase price is reduced because of adjacent landfarm that may contain treated soils that can be used to fill excavation pit.

Alternatives 3 (Continued): Long-term Monitoring After Excavation (LTM plan differs from Alternative 1)

Misc calculations

Number of LTM wells:		
Number of wells:	7	
Depth each:	15	ft

Cost calculations

Description	Unit	Qty.	Unit Price	Subtotal	Total	Source (If applicable)
Well Installation					$ 7,350	
Mobilization	ea	1	$ 2,000	$ 2,000		
Well Installation	ln ft	105	$ 50	$ 5,250		
Soil Disposal	cy	1	$ 100	$ 100		*assumes disposal at nearby land treatment farm
Product Hauling/ Disposal (Fuel(ann))	gal	600	$0.25	$ 150	$ 150	
Wastewater Disposal	gal	50,000	$0.05	$ 2,500	$ 2,500	land treatment farm